ENGINEERING AND MINING JOURNAL

OCTOBER, 1940

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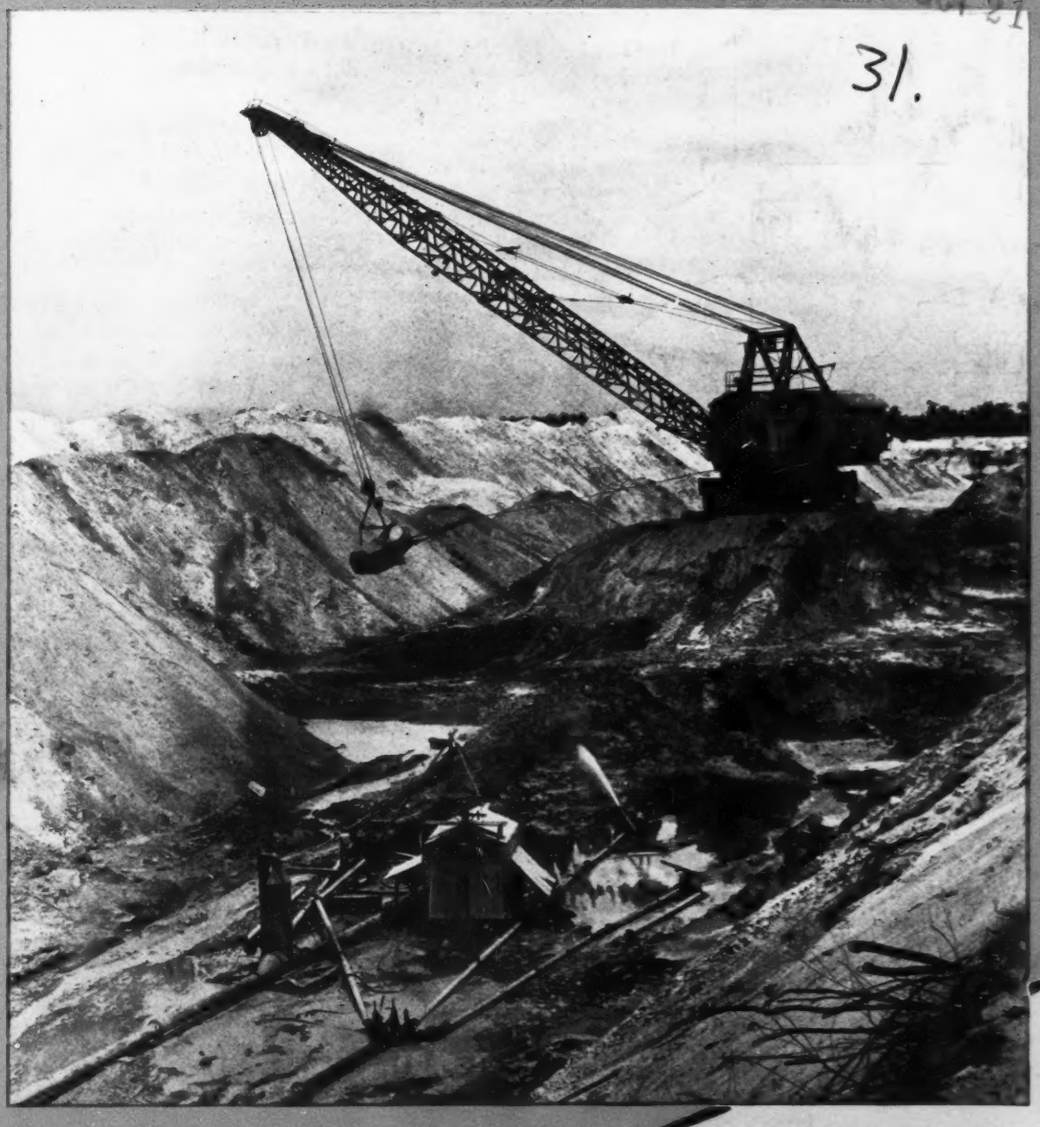

American Cyanamid Company's Oak Ridge phosphate mine, in Florida, the deepest stripping job in the pebble field. Both the dragline and the stripping procedure are unique. See page 39.

In this issue

Tomorrow's Mining Methods
Milling Operations of North Camarines Gold
Filtering Cyanide Precipitate with Diatomite
Flotation in the XV Century • Phosphate in Florida
Bolivia for Strategic Metals
Complete Contents on page 27

PACKLESS
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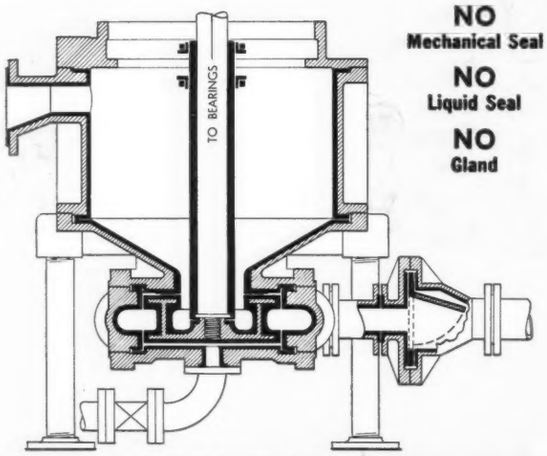
NO
Stuffing Box

NO
Packing

NO
Mechanical Seal

NO
Liquid Seal

NO
Gland



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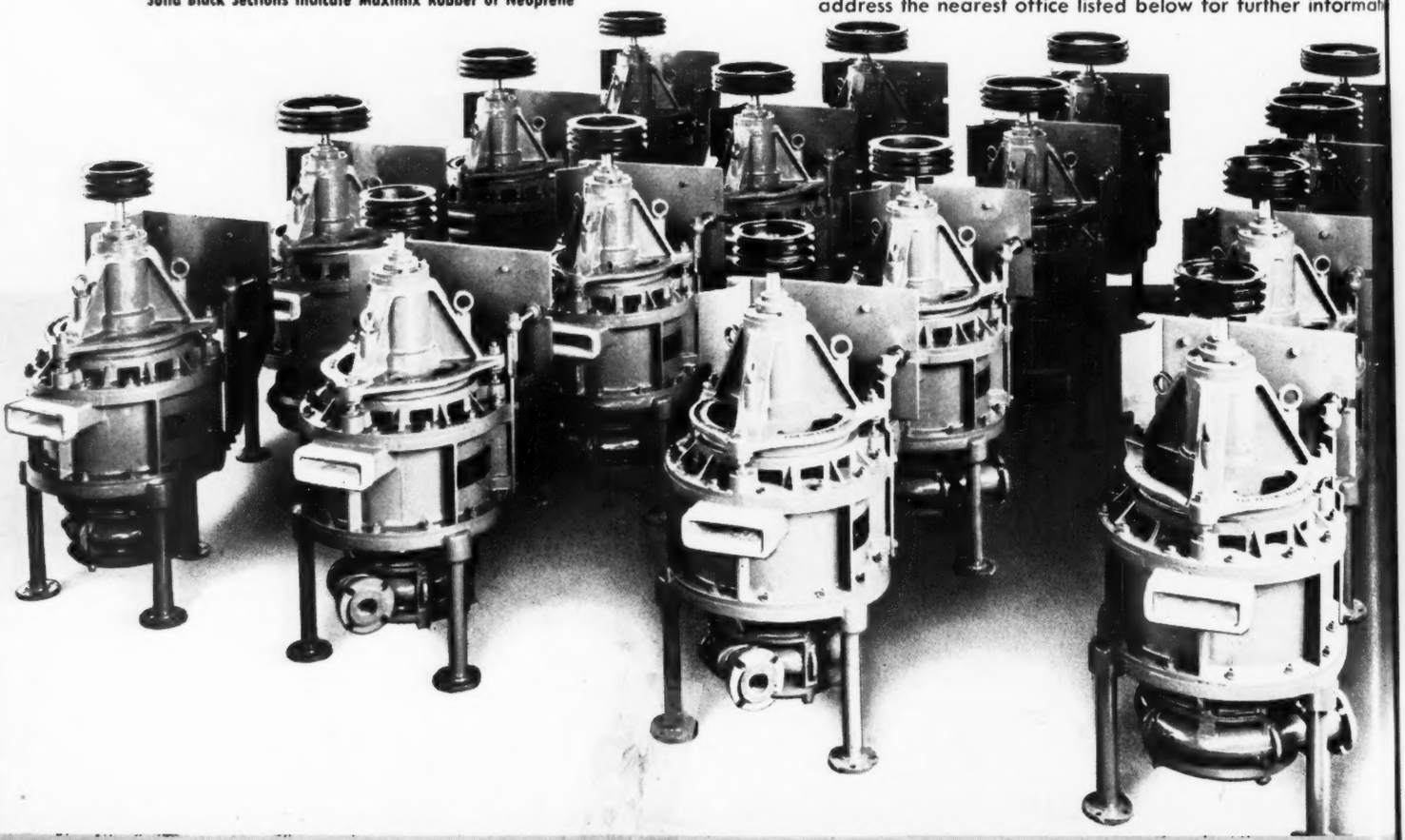

HYDROSEAL, PACKLESS AND MAXIMIX DESIGNS ARE COVERED BY PATENTS AND APPLICATIONS IN THE MAJOR MINING CENTERS OF THE WORLD AND CAN BE PURCHASED ONLY THROUGH THESE COMPA

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In Washington things do move! At last the Superintendent of Documents has been led to advertise his wares. First, publicity, now some months old, through press releases covering Bureau and Survey publications. Now the "direct-by-mail" piece announcing, in one case, the good points of the Survey's Professional Paper 148, on Leadville, and ending with "Enclosed please find" and actually a dotted line. This is getting down to business. The producer must also sell. But why, oh why, must these Government bureaus produce so much?

▼

Page Merlin. A prize of 10,000 reichsmarks ($1,800) is offered in Germany by the Army High Command for the invention of a chemical storage system that meets all the requirements of the ordinary lead storage battery now in use. The dead line is Jan. 1, 1941, and the German Army will have the right to use all proposals without cost. According to the U.S. Bureau of Mines, this would reduce Germany's need for lead, nickel, cadmium, and mercury and permit vehicles to run without such fuels as gasoline and diesel oil.

▼

Tin linings that are thick and adherent can now be applied to large pieces of apparatus, such as used in the food industry, according to the International Tin Research and Development Council's January quarterly review, as a result of recent improvements in electroplating technique. These are far more serviceable than hot-dipped coatings. Still another application of electro-deposited tin is as a coating on metal surfaces in rubbing contact, such as pistons and piston rings and bearing surfaces. The tin is said not only to improve lubrication but also to eliminate abrasion during running-in processes.

▼

Italy is reported now recovering vanadium from naphtha-soot collected from the smokestacks of Italian ships, her navy and industrial plants and sent to a concentration plant in Genoa.

H. C. PARMELEE
Editorial Director

ENGINEERING AND MINING JOURNAL

H. W. CLARKE
Vice-President

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COVER ILLUSTRATION: Oak Ridge phosphate mine, in Florida, a property of the American Cyanamid Company. It is the deepest stripping operation in the pebble field. Dragline and stripping procedure are both unusual. Cover space released for editorial use by Ingersoll-Rand, 11 Broadway, New York City

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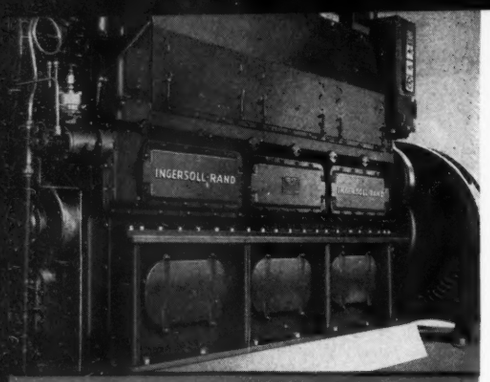
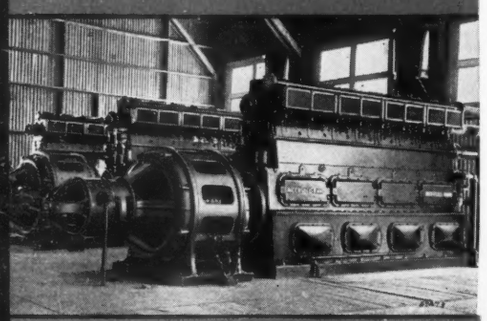
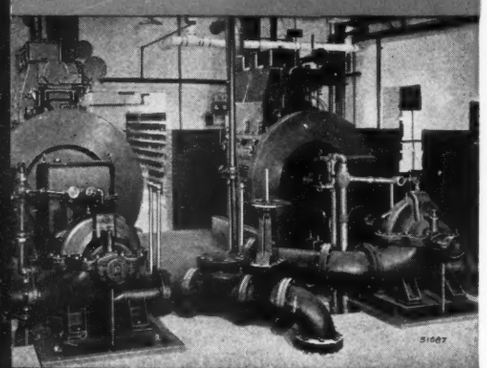


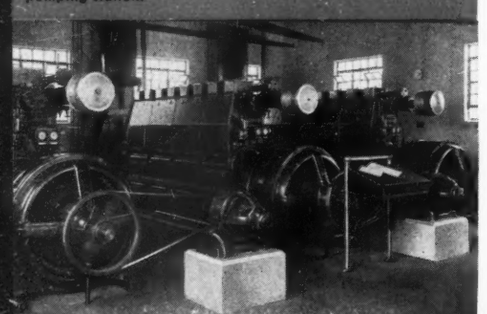
A Type S diesel generating power for a gold mine.



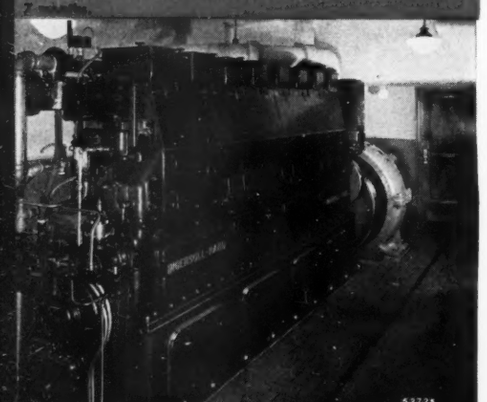
These three Type S units furnished power for constructing a large dam.



Two Ingersoll-Rand diesel-pumping units in a municipal pumping station.



In an oil refinery 5300 miles from the factory, these 3 Type S engines were put into service by the refinery's own staff, and ran without a stop at practically full load for more than 7 months.



This Type S was installed (fully assembled) through a narrow shaft to furnish power for an office building. Note the low headroom.

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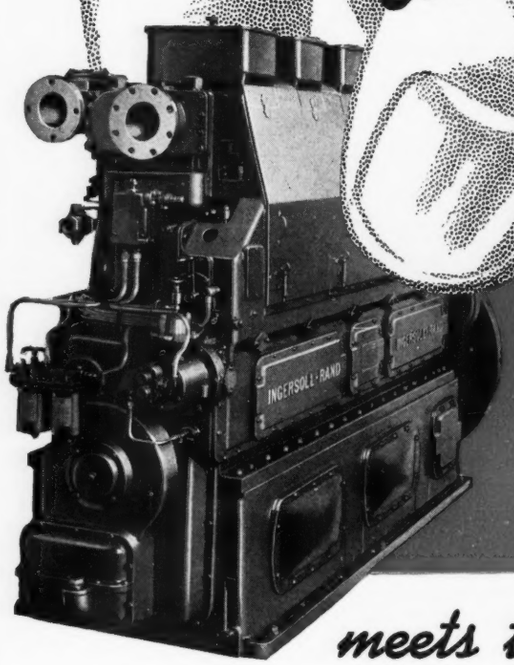

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- For driving high-speed centrifugal pumps or blowers through single reduction gearing.
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Abnormal Metal Markets

PRODUCERS of non-ferrous metals were hard pressed last month to meet the extraordinary demands of consumers as the full impact of the war began to be felt in the domestic market. Combined purchases of copper, lead, and zinc during September assumed record proportions.

Consumption of copper by domestic fabricating plants during August was approximately 89,000 tons, based on shipments by mills and foundries as reported by the American Bureau of Metal Statistics. This large total is to be compared with a monthly average consumption of 73,437 tons for the first eight months of 1940 and a monthly average of 63,250 tons for all of 1939. The increase in the use of copper during August was generally attributed to large export orders for fabricated products, mostly for British account. Activity at fabricating plants during September was just about as high as in August. With the defense program of the United States now getting under way, the rate of activity is certain to be high for many months to come. Producers of copper are preparing to increase output.

Zinc has been affected by developments abroad to an even greater extent than copper. The large smelting capacity of Belgium, France, Holland, and Norway is no longer available to Great Britain, who, it now appears, relied on these sources for part of her needs, even though Empire output of zinc was large. Adjustments had to be made quickly, and the zinc industry of the United States was called upon to make up deficiencies. Galvanizers and brass makers obtained large orders from the British. This business tightened the supply situation here, and the domestic consumer began to worry about the future. Then national defense orders for zinc-bearing products were placed in large volume, and before September ended smelting capacity in this country was being pushed to the limit.

Lead, in contrast to copper and zinc, has presented a fairly normal marketing problem. Enough foreign lead has moved into the United States to offset any shortage in domestic production. Large importations of pig lead, now stored in bonded warehouses, could easily jump the tariff barrier if the price were to advance even moderately above 5¢ New York.

Tin arrivals in this country from the Far East have been large. Late in September it was announced in Washington that supplies stored in this country, combined with tonnages afloat, are adequate to meet domestic requirements for from nine to twelve months. Construction of a domestic smelter to treat Bolivian concentrate is now virtually assured.

Obviously, the abnormal demand for metals in the past sixty days has not only put a temporary strain on supply but has also moderately advanced the price of the major non-ferrous metals. For the sake of the record, and in order to place the responsibility for these extraordinary conditions where it belongs, it is well to remember a few facts that otherwise may be overlooked: Three major factors have contributed to a domestic boom in metals that upset all earlier calculations. First, the military collapse of the Low Countries and France; second, the growing importance of our own defense program as a stimulant to business; and third, the understandable wish of domestic consumers to build up stocks of fabricated materials as insurance against possible acute shortages developing later out of war demand. These factors combined to expand domestic metal markets far beyond previous expectations of producers who, far from creating artificial shortage in metals, are doing all in their power to relieve a tight situation. When consumers learn that adjustments are being made to meet the emergency, more orderly markets will prevail.

Metal Price Control

IT WAS INEVITABLE that the heavy demand for non-ferrous metals, discussed above, should bring about a moderate rise in prices. Indeed, the large volume of business combined with the unusual demand was such as to justify even greater price increases than actually occurred. But small as they were, they attracted the attention of Washington, with the result that warnings against runaway prices and comments on price control were publicized by several Washington agencies.

The Defense Commission recognized that sudden short-term demands for defense needs might create an "artificial price-supply-demand pressure" that would cause prices of key commodities like metals to get out of line. As a correc-

tive, the commission suggested the advisability of conferences between producers and consumers to discuss the situation openly.

The Bureau of Labor Statistics also warned against rising prices, and the Brookings Institution made public a report to the War Department on means of preventing serious price inflation arising out of abnormal activity in war industries. Earlier the office of the Coordinator of Government Purchases had warned against the dangers to industry of rapidly rising prices, and cited the disastrous conditions following the first World War, when prices dropped from their war-time level and caught consumers with large inventories acquired at high prices. It was pointed out that the effect of great price dislocations now would be even worse than in 1920–21.

In our judgment these warnings are not to be construed as unfriendly threats against industry. Rather they are sincere attempts on the part of experienced economists and business experts to try in every way to avoid economic pitfalls and dislocations and keep the industrial machine as nearly in balance as possible. Prices are under close scrutiny and a determined effort will be made by the Federal authorities to keep them in line.

For several reasons there is little likelihood of non-ferrous metal prices skyrocketing as they did twenty-five years ago. There is no imminent critical shortage of metals, and time is working on the side of adjusting supply to demand. Britain is beginning to furnish her own copper and zinc for munitions made in the United States. Domestic production of copper and zinc is on the increase; and in the case of copper the 4¢ excise tax on imports effectually puts a ceiling on the domestic price. So the outlook for stability in metal prices is good. Unwarranted advances are not likely to occur; but if they do, correctives will be applied.

To Be Opened A.D. 6939

AT THE STROKE OF NOON, September 23, 1940, the Westinghouse Time Capsule, an 800-pound "message to the future," was sealed in a 50-foot well in front of the Westinghouse building at the New York World's Fair, where it had been deposited just two years ago. The capsule contains as nearly complete and indestructible a record of twentieth century civilization as it was possible for scientists and engineers to devise. Composed of cupaloy, an alloy of copper, chromium, and silver, and lined with an envelope of Pyrex glass, the capsule contains about 35 small articles of common use; 75 samples of textiles and other materials; microfilm reproductions of books, magazines, and pictures; newsreel sound film; and other sources of information about our time. The microfilm reproductions contain the equivalent of more than 100 ordinary books, a total of more than 22,000 pages, more than 10,000,000 words and 1,000 pictures. All told, the contents of the capsule are intended to convey to the archeologists of the future a clear picture of life and civilization A. D. 1939.

How long the capsule will remain in its present position no one knows, but its sponsors hope that it will rest undisturbed for 5,000 years. To aid in its recovery and in the understanding of its contents, a book of record has been prepared and deposited in hundreds of libraries, museums, monasteries, convents, lamaseries, temples, and other safe repositories throughout the world. Not the least interesting item in the book is a brief article on a geophysical method of seeking metallic substances beneath the ground. Further aids to the exact location of the capsule are data giving the mean position of the North Star and the heliocentric longitudes of the planets on January 1, 1939. Latitude and longitude of the location of the capsule are given to the thousandth part of a second of arc.

Novel in its conception and brilliant in its execution, the Time Capsule is a deliberate and carefully planned attempt to convey to people of the future a message from our time to theirs. In that effort the labor of engineers and scientists of our time has played a conspicuous part.

Expert Opinion

AT A RECENT press conference at the White House a correspondent asked the President if he would comment on the bill providing for Federal mine inspection. He is reported to have replied that, although he was not familiar with the bill, he felt that the objective—safety—was probably necessary. The opinion was expressed that mine accidents are too frequent and severe on account of inefficient inspection. He added that he thought the Bureau of Mines had approved the measure. What he did not tell the correspondents was that, after Director Finch had disagreed with Secretary Ickes on the wisdom and necessity of Federal mine inspection, and had been removed from office, the Secretary gave orders that if the Bureau's opinion were asked on the measure, official approval should be given. Not content with expressing a personal opinion on a subject of which he had no competent knowledge, the President sought to convey the impression that technical experts approved the bill. And this despite his recent public disclaimer that he refrains from commenting on pending legislation.

TOMORROW'S MINING METHODS

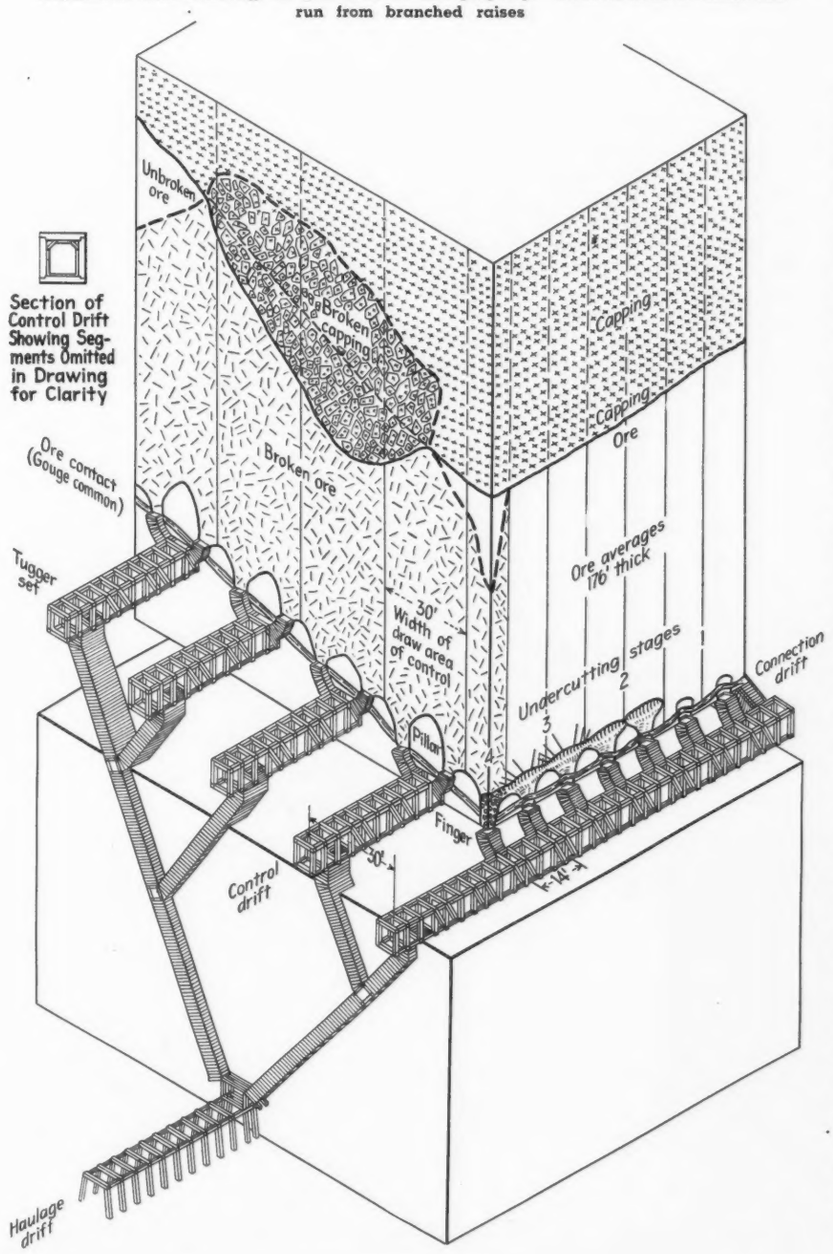
as suggested by

Slusher Mining Practice

at Consolidated Coppermines

Mark A. Smith
Mining Engineer
Box 138, Ruth, Nev.

Fig. 1 . . . Typical block at Consolidated Coppermines, illustrating cave mining in conjunction with slushing, as practiced at this property. Parallel slusher drifts are run from branched raises



THOUGH slushing in cave mining is relatively new the practice has spread rapidly in the last three years. The history of underground slusher mining clearly shows it to be in an embryonic condition of development. Viewed in this background slushing is seen to be in an evolutionary state, which implies continued expansion.

History of Slushing—Before the turn of the century improvised scraping with slips and single-drum hoists was used for driving drifts. With the introduction of double-drum slusher hoists in about 1912, slushing was introduced in top-slicing and sublevel caving, and it found a limited use in other mining methods. The first slushing in porphyry mines consisted in salvaging operations to recover ore between the undercut horizon and the motor haulage level that could not be mined by the branch-raise method. Following this, slushing was used in marginal and isolated areas and in areas where the ore was either too thin or too high above the haulage level to stand the cost of branch-raise mining. These slusher operations for the most part were small and met with indifferent success, since they were regarded as makeshifts having a limited use. Plans were made in 1931 to replace branch-raising with slusher mining in certain areas of the Emma Nevada mine of Consolidated Coppermines Corporation. The work was started in the early part of 1932 and was well under way when operations were suspended later in the same year. Upon reopening of the mine in 1937 this work was resumed and the slusher block produced the first ore. These operations proved successful from the start and since then most of the tonnage produced at the Emma Nevada mine has come from slusher operations. During the suspension of operations at Coppermines a modification of the slusher method was put in operation by the Climax Molybdenum Corporation at Climax, Colo. During 1938-

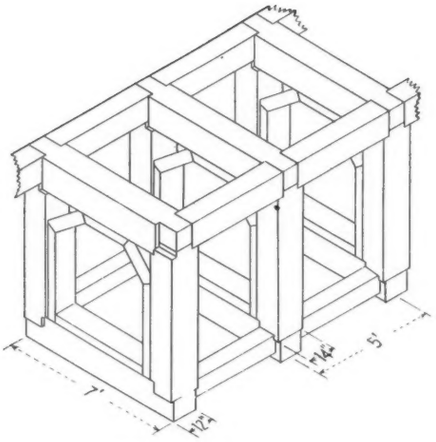


FIG. 2 — Slusher Set

Fig. 2 . . . Slusher drift set used at present time in Consolidated Coppermines workings. It offers several advantages

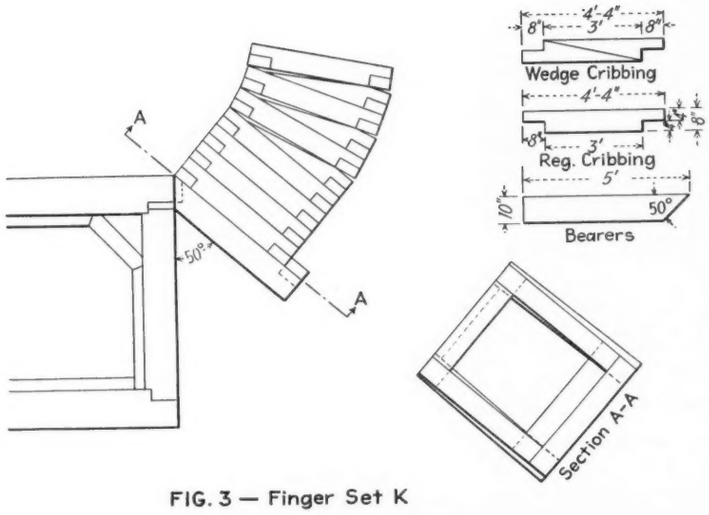


FIG. 3 — Finger Set K

Fig. 3 . . . Design of a finger set. Fingers are spaced 15 ft. apart along the slusher drift and are 50 deg. from the horizontal

1939 slushing on a small scale was introduced by Phelps Dodge at Bisbee, Ariz.; by Nevada Consolidated at Ruth, Nev.; and by Inspiration Consolidated at Miami, Ariz.

These slusher operations are not to be confused with shaker conveyor mining, subsequently introduced by Consolidated Coppermines at Kimberly, Nev.; by Miami Copper at Miami, Ariz.; and Nevada Consolidated, Ray, Ariz.

Character of Ground at Coppermines —The Emma Nevada orebody is a thoroughly fractured and altered blanket monzonite porphyry varying in thickness from 40 to 325 ft. and averaging 175 ft. Mineralization, which is primary, was subsequent to the intrusion of the porphyry, the hydrothermal solutions following the shattered zone within the porphyry mass. The ore porphyry in general is stronger than the footwall porphyry. It breaks finely in caving and has the appearance of being crushed. As delivered to the mill the ore sizes 60 per cent minus 1 in., which makes it ideal for slushing. The line of demarcation between the ore and waste is sharp. The ore porphyry is underlain by a younger, and for the most part unmineralized, monzonite porphyry, locally known as "peanut" porphyry because the prominence of well-formed orthoclase phenocrysts gives it the appearance of peanut brittle. Footwall porphyry near the ore contact is a gummy, plastic breccia, appropriately called "chewing-gum gough." This brecciated zone, in which many slickensides are present, varies from 2 to 40 ft. in thickness. Movement along the slickensides, facilitated by water acting as a lubricant, is commonly observed after the equilibrium of the rock has been disturbed. These movements, combined with the inherent weakness of the footwall near the ore, make development and maintenance at the Emma Nevada mine the major operating problem.

The Standard Slusher Method— Three methods of mining are in use at present—the branch-raise, the sub-slusher, and the standard slusher methods. More than seven million tons of ore have been mined—roughly about equal amounts by each method—since the reopening of the mine in 1937. The slusher methods have produced over 6,000 tons daily for long periods. Each of the three methods has particular advantages under certain conditions. The sub-slusher method, being a half-way step between the branch-raise and the standard slusher methods, has some of the good points and some of the objectionable points of each of the other methods. The standard slusher method, which seems to hold greatest promise for expansion in the future, is described in this paper.

An analysis of the economical and physical factors of slushing preferably precedes a discussion of operating details. But a comprehensive presentation of the various factors entails a comparison with the competitive gravity methods. Though these interesting problems, at present quite involved, are subject of comparative analysis, they are obviously outside the scope of a description of slusher practices at Coppermines. Here the relative advantages and disadvantages of slushing are enumerated, to present a suitable background for understand-

Drilling round in face of slusher drift

Drilling pillars in undercut

ing the principles of mining porphyry orebodies by slusher methods.

Slushing Versus Branch-Raising—The principal advantage of slusher mining over branch-raise mining is the saving in cost of development. Slusher development costs at Consolidated Coppermines, based on cost per square foot of undercut area instead of cost per ton, will average less than half the cost of branch-raise development. To be weighed against the development savings is the cost of mechanically handling the ore. Where the ore is thin and high above the haulage level, slusher mining makes a maximum saving. On the other hand, if the ore is thick and lies close to the haulage level the cost of mechanically transporting the ore may more than offset the development savings. In weighing costs of mechanically moving ore against development savings the important points to be taken into consideration are (a) the character of the ground, because this determines the unit cost; (b) the height of ore above the drift, since this determines the amount of development; (c) the thickness of the orebody; and (d) the cost of mechanically transporting the ore.

Closely allied with slushing and preparatory work is maintenance, an important but unpredictable cost item, upon which success or failure of the method may depend. Maintenance costs in a given area, with ground conditions being equal, will vary directly with the amount of development to be maintained. Again maintenance will vary with the efficiency of supervision, with ventilation, and with the supply delivery system. In these the slusher method has an undisputable advantage over the branch-raise method.

Because of the weakness of the footwall in proximity to the ore—where most of the preparatory work is located—heavy timbering is required, which means costly preparatory work and often costlier repairs. The obvious means of reducing these costs, assuming that the timbers have been correctly designed and that precautionary steps have been taken to insure proper installation and maintenance, is to select or devise a system having a minimum amount of preparatory work. The standard slusher method was devised to meet these requirements. Preparatory work in the Kimberly slusher method is not reduced to an absolute minimum, as I proposed, for example, in a preceding article,[1] because it must dovetail into the branch-raise method.

Before a final decision is made on the mining method to be used in a block, a comparative analytical study is made. Plate-glass models showing proposed development layouts, motor haulage drifts, and ore-waste contacts are made for study. These models aid in solving the development problems which would be difficult to visualize otherwise.

Standard Slusher Development Methods—Development requirements at Coppermines are somewhat more exacting than at other porphyry mines. The concentration of values near the bottom contact makes it desirable to recover as much of this ore as possible. At the same time the sharp line between ore and waste makes it equally desirable to mine as little footwall, which is always barren, as possible. Another economic requirement is that the whole thickness of the orebody be mined in one lift.

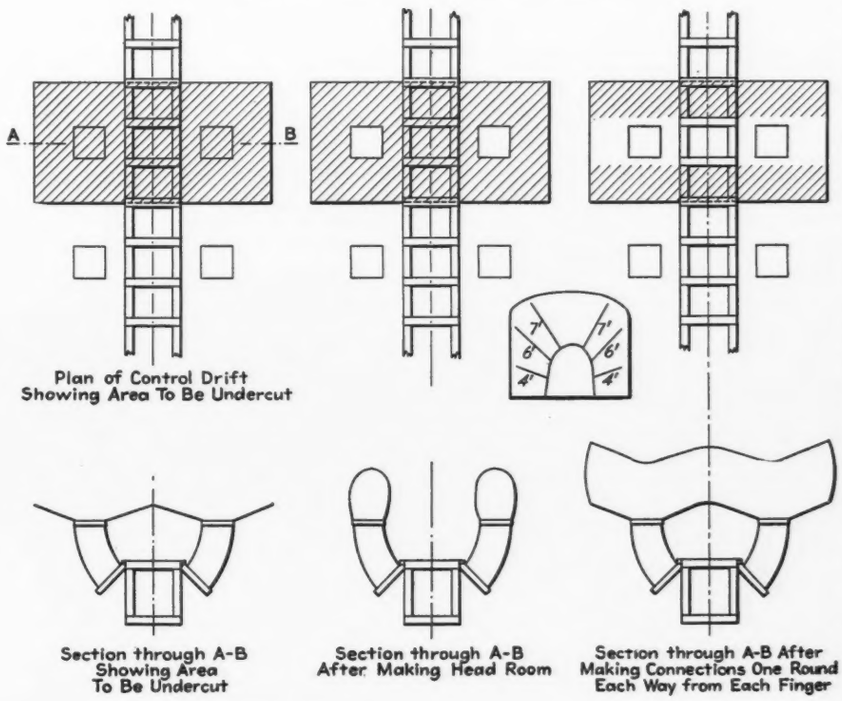
An almost endless number of variations and combinations of Standard slusher development layouts can be reduced to three elementary plans, (1) slusher drifts running parallel to the motor haulage drifts, (2) slusher drifts running perpendicular to the motor haulage drifts, and (3) cross-slushing (or cross-conveying) from either parallel or perpendicular slusher drifts to motor haulage drifts. If cross-slushing is not employed, the parallel slusher drifts are run from branched raises as shown in Fig. 1. Though this plan is restricted to high-lying ore, the development costs are slightly higher than in the normal slusher drift plan, yet it has the advantage in that the pillar between the drift and the undercut horizon protects the haulage drifts from excessive weight. Perpendicular slusher drifts can be placed at any horizon, though they are best suited for low-lying ore. Where the ore is at the haulage level horizon, tugger stations are installed in the haulage drift on the opposite side of the slusher drift, and the ore is scraped directly into mine cars. Though all raising costs are eliminated, this is not the most desirable method, because drift repairs may increase mining costs and interfere with production.

The farther apart drifts and raises are placed for mining a given area, the cheaper the preparatory—and maintenance—work per square foot of area. The principal factor that governs preparatory costs is the spacing of draw points or fingers, which in turn is governed by the character of the ore. Draw points at Coppermines are on 15-ft. centers. At other mines using the caving system draw points will vary from 12½-ft. centers for sticky ore to 40-ft. centers for hard, coarse ore. Raise and drift costs vary directly with finger spacing, being just half as much for 30-ft. centers as for 15-ft. centers.

Another important factor governing slusher development cost is slushing distance, which is governed by the character of the footwall. A slushing distance of 120 ft. has been found practical in the weakest ground at Coppermines, thus placing the haulage drifts on 240-ft. centers with the perpendicular slusher method, and the raises on 240-ft. centers with the parallel slusher method. Raise costs, a negligible item in slusher mining, are governed by the height of the ore above the drift. In low-lying ore the raises are placed on 30-ft. centers, in medium high ore on 60-ft. centers, and in high-lying ore with perpendicu-

[1] *E. & M. J.*, March, 1940, pp. 43–47.

Fig. 4 . . . Successive stages of undercutting



lar slusher drifts on 240-ft. centers. In general if the height of the ore above the haulage drift is not sufficient to permit perpendicular drifts on 240-ft. raise centers, slusher drifts parallel to the haulage drift will be more economical.

Details of Slusher Development—All openings are kept as small as possible because the ground is extremely weak and requires heavy timbering. The main haulage drift and extraction laterals have a cap 6 ft. 6 in. in the clear, which is bridged in heavy or swelling ground. The posts are 8 ft. 8 in. long on the dry side and 9 ft. on the ditch side, and are generally set with a batter of $1\frac{3}{4}$ in. per foot. All posts, caps, and bridges are of 12 x12-in. Douglas fir, and split lagging are used for cover and side lacing. Ten-ton trolly locomotives and drop-bottom cars carrying a 5-ton pay load constitute the haulage equipment. A 36-in. gage track of 75-lb. rail with welded joints is used.

All raises are cribbed, the timber size being determined by the character of the ground and the tonnage which is to pass through the raises. Where the ground is fairly strong, 4x12-in. cribbing is used, and where it is weak, or where the raise serves a large tonnage and consequent excessive wear is anticipated, 6x12-in. cribbing is used. A raise must serve about eight times more tonnage in slusher mining than in branch-raise mining. For this reason the manway and chute compartments are made the same size, which is 4 ft. square inside, and are interchangeable. If the chute compartment has to be repaired, the manway can be made into a chute quickly by taking the ladder out and installing a gate in the pony set. The manway compartment has ample room for a ladderway and a slide for hoisting timbers and other supplies. Air-lift down-cut vertical gates are installed in the slusher raises where large tonnages are handled daily, which speeds up loading and materially reduces loading costs. One man on the air gates has loaded 2,000 tons in a single shift.

The accompanying tabulation shows an idealized muck-pulling shift.

An Idealized Slushing Shift

		Production Tons
A. M.		
7:50	Start slushing ore blasted down by repair crew at end of previous shift	25
8:14	Punch fingers	..
8:24	Start slushing	31
8:54	Punch fingers	..
9:04	Start slushing, fingers continue to run well	31
9:34	Punch fingers, more time is required because some fingers are packed	..
9:48	Start slushing, fingers run less ore	25
10:12	Punch fingers, some fingers full of boulders, some packed	..
10:27	Start slushing, fingers run poorly	15
10:42	Drill auger holes in packed fingers	..
10:57	Go after powder and primers	..
11:07	Load auger holes and place bombs between boulders	.
11:20	Spit fuse and go to lunch while smoke and gas clear out	.
P. M.		
12:05	Start slushing ore blasted down	31
12:35	Punch fingers	..
12:45	Start slushing ore which is running well	31
1:15	Punch fingers	..
1:25	Start slushing ore	31
1:55	Punch fingers	..
2:07	Start slushing	25
2:31	Punch fingers, some fingers full of boulders, some packed	..
2:45	Start slushing	20
3:05	Punch remaining fingers	..
3:22	Start slushing	15
3:37	Hang up cable	..
3:40	Start out of the stope	..
	Total	280

The success of slusher mining hinges almost entirely on the design, installation, and maintenance of the slusher drifts and draw fingers. The best horizon for recovering ore and reducing repair costs is to place the slusher drifts about 10 ft. below the ore-waste contact, and as the bottom contour of the ore undulates, they are laid out to strike this distance as an average. It has been found desirable to keep the slusher drifts nearly horizontal. The maximum grade used is 4 in. per 5-ft. set; where the grade is steeper than this, the drift sets ride upgrade and are difficult to maintain. Where the bottom contour dips steeply or is step-faulted, ideal layouts are not feasible, as the ore may, in extreme cases, be 25 or 30 ft. above the drift at one end and dip into the drift at the other end. This irregularity is satisfactorily taken care of in the finger construction. Where the ore is high above the drift the fingers are extended up to the ore contact. The minimum length of the fingers is 10 ft. and the maximum length above the drift cap is about 25 ft.

When a standard slusher raise has been completed and the cribbing leveled off (generally at a point about 18 ft. below the ore), a chute set and manway set are installed at the top of the raise. The tugger station set is next installed, and after two or three slusher drift sets are placed, the tugger hoist is set up so that the muck made in drifting may be scraped to the raise. The drift and finger crew consist of three miners who work in cooperation on a bonus system. Generally two men work in the face and one man on the fingers. A good crew will advance the face 5 ft.—one complete set—per shift, and the man installing the fingers keeps pace with the drift crew. The contract crews place all the timbers, including segment sets and a temporary 2-in. floor for scraping. Average time required to slush out a drift round is 30 min.

The slusher drift posts are plumb and are 12 by 14 in. by 6 ft. 2 in. long. The drift caps and sills have the same frame, making them interchangeable, and are 12 by 14 in. by 5 ft. inside the frame, as shown in Fig. 2. An important feature of this set is the 12x14-ft. sill. Light sill failed as fast as they were put in, the posts being driven down into the ground and pushed in at the bottom. Most of the failures of former sets were at the junction of the sill and post, which is a difficult place to relieve, because the muck is pushed in between the posts by the scraper. The present drift set (Fig. 2) is designed to overcome this particular difficulty. It is important to provide a good drift bottom for slushing operations. The sills must be strong enough to prevent buckling and breaking. The practice of installing three light rails for a scraping surface has proved satisfactory.

To minimize maintenance it has been found essential in slusher drift

Loading final round in an undercut. The men are standing on stulls on top of finger raise

Close up of a miner punching finger. The miner's tool is a bar 5 to 7 ft. long of 1 in. pipe sharpened at one end

and finger installation to keep overbreaking at a minimum. To prevent this the development crews are penalized if they overbreak where it is avoidable. By careful development the pillars between the slusher drifts and the cones between the draw points are kept to a maximum size and aid materially in supporting the overlying weight and reducing repair costs.

The draw fingers are placed on 15-ft. centers along the slusher drift and are constructed of 8x8-in. cribbing fitting skin to skin and resting on 10x10-in. bearers. The fingers are 3x3-ft. inside and installed at 50-deg. angle from the horizontal, as shown in Fig. 3. The timbered portion of the finger extends 5 ft. above the top of the drift caps. If the fingers are in ore, one vertical round is taken out above the cribbing; if the fingers are in waste, they are extended up to the ore without cribbing. The fingers are designed to allow the chute blaster to bomb or "punch" from the slusher drift. Long cribbed fingers were tried in the early stage of slusher mining, but the cribbing crushed or was blasted out, resulting in excessive maintenance. Long cribbed fingers were also found too hazardous for the chute blasters to climb up into to bomb in case of hang-ups.

The length of the slusher drifts has a direct bearing on the economy and success of slushing, because savings in main level and raise headings are increased as the slusher drifts are lengthened. It has been found necessary to do all the slushing on one shift at the Emma Nevada mine, so as to leave the opposite shift free for repairs. By using a drift length of 120 ft., it is practical to draw and slush the ore on one shift at a rate which good mining and control dictate. The length of the slusher drifts may be increased in thin ore or in strong ground, because the shorter drift life may make heavy repairs unnecessary.

Undercutting—The undercut is designed to keep as much solid ground as possible between the top of the draw points and the drifts, to protect them from weight. All undercutting is done with rotating stopers, and all holes are drilled 45 deg. or steeper, which results in pyramids being left between all draw points. Close supervision is necessary to insure that no pillars are left in the undercut to throw undue weight on the drifts and fingers and cause piping when the ore is drawn. It is considered just as important not to overbreak into adjacent virgin ground as it is to underbreak and leave pillars. Drawings showing the stages of undercutting are furnished the undercut bosses, and the instructions are rigidly enforced. The weakest ore is near the contact, and undercutting must be rapid to prevent caving, which might drive the crew out and result in leaving pillars.

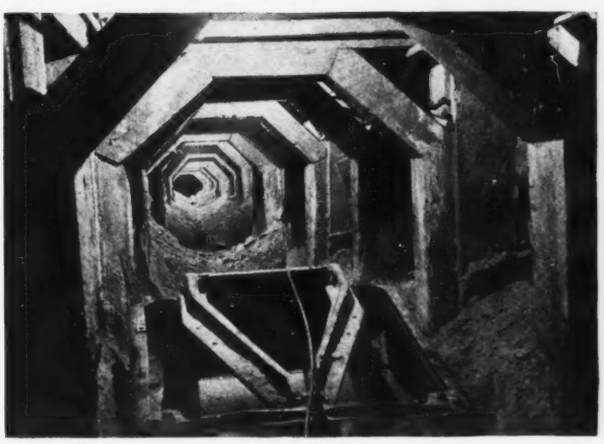
Two Rounds Drilled

Undercutting is done on a bonus system and a crew consists of two men. The unit is one pair of fingers comprising 450 sq. ft., and an average of 2½ shifts is required to undercut the unit. The undercutting starts in the middle of the drift and retreats first to the far end, and then to the chute, always breaking to the cave. The first stage in undercutting, if the finger is in ore, is to drill two raise rounds, belling out the last round on the footwall side. If the finger is in waste it is extended up to the ore and the last round is belled out. The second stage is to join the fingers across the top of the drift by inclined connections, which are made as large as the ground will permit in order to take care of the swell when the final round is blasted, as shown in Fig. 4. The last stage is to drill out the back and pillars from the inclined connections, using eight radial rounds, 4 ft. apart, of five holes each. It has been found impractical and unsafe partly to undercut large areas and then shoot out the pillars as is customary at most porphyry mines. In the harder parts of the orebody, and in blocks bounded on all sides by virgin ground, short shrinkage cut-offs may be used in the corners of the blocks. When undercutting is completed, a bottom slice of ore 30 ft. wide, 8 ft. or more high, and the length of the slusher drift has been removed.

Slushing Detail—As soon as a unit of the undercut is blasted, miners on the opposite shift start drawing ore. The newly undercut fingers often have pockets of gas trapped behind the ore, and because of the danger of being overcome by gas, two miners work together. Much hand-augering and blasting are necessary to induce recently undercut fingers to cave, and this requires two men. Within a few days the newly undercut area starts caving freely and normal operations begin. As pulling muck and repairing are each specialized jobs requiring a practiced routine and a developed skill, an endeavor is made to keep the slusher operator pulling muck, and to keep a repair man on repairs. It can be said that as a general rule the younger, more agile men become the best slusher operators, and the older and more experienced miners the best repair men.

When the block has finally been induced to cave by drawing out the undercut portion, all the drawing and slushing in each drift is done by two miners on one shift. The miners start on the last pair of fingers in the slusher drift, barring or "punching" the ore down into the drift, working back towards the chute. The miner's main tool is a bar 5 to 7 ft. long made of 1-in. pipe sharpened at one end. A finger may either become packed or the coarse ore become tightly wedged. The packed condition is alleviated by drilling hand-auger holes and blasting. Wedged boulders are blasted by bombs made of a number of sticks of dynamite tied to the end of a long, light blasting stick and placed tightly between the boulders. The muck-pulling cycles are continued on each shift until lunch time, unless blasting must be resorted to earlier, at which time packed and plugged fingers are blasted.

Slusher drift showing all fingers down and scraper going back to start pulling



Slusher drift about 120 ft. long after being slushed clean. The author in the drift

Dangers of Careless Sampling and Assaying

Success or failure of an enterprise depends on precise checking of results

B. W. Hill
McKinley Mines,
Yreka, California

WHEN the engineer submits his samples to an assay office he hopes the grade will at least fall under the category of "medium ores." Assume the ore sampled was such that 10 lb. per foot of vein was required to obtain a satisfactory sample, and that the vein was 5 ft. wide. The crushing procedure would then be as follows:

50 lb. crushed to 1.6 mm., or 10 mesh, take 20 lb.

20 lb. crushed to 0.80 mm., or 20 mesh, take 2 lb.

2 lb. reduced to 100 mesh for assay.

Should the engineer have determined that the probable assay value of his samples falls under any other category than medium-grade ores, he would of course see to it that the crushing and reduction in weight, follow the table in Richards's "Ore Dressing" Vol. 2, page 852, for that particular grade of ore.

The importance of proper reduction of ore samples cannot be overestimated, and neglect may be disastrous, as is shown by an occurrence in the Western United States some years ago. The engineer in charge of sampling operations submitted his samples to a commercial assayer. There were several hundred samples, each weighing approximately 100 lb. and each ranging from fines to pieces containing as much as 4 cu.in. The procedure followed was to reduce each sample to ¼ in. and put repeatedly through a Jones sampler until the part remaining as a sample weighed about 2 lb. Then the rest of the sample was rejected. The 2 lb. was reduced in the pulverizer to pass 100 mesh, and used for the assay sample. The mill that was erected, based on the results so obtained, operated three months.

In an effort to check the work in the instance related in the foregoing, the final pulps, ground to 100 mesh, were frequently submitted to other assayers after the first man had obtained his results. Of course the assays checked, as the error was undoubtedly in the method of reduction.

Another "reputable" assayer reported from $3 to $6 per ton in gold in a series of 50-lb. samples submitted to him. When asked for his rejects he produced boxes that were filled with material ranging from dust to ¼ in. in diameter and larger. A new series of samples were submitted to this assayer, with the request that they be reduced in accordance with the instructions of the engineer in charge of sampling. To be certain these instructions were followed, the engineer stated to the assayer his intention of supervising the crushing, but at the same time offering to pay for the additional work involved. He was, however, ordered from the office and requested to take his samples elsewhere. These samples, which had been taken from exactly the same cuts as had the samples on which $3 to $6 per ton in gold had been reported, were submitted to another assay office, with the engineer in charge of the sampling supervising the crushing. Results obtained were in all cases less than $1 per ton.

The engineer is sometimes required to sample an ore dump. The method commonly used is to make cuts or trenches into the dump, and to use all of the material removed for the sample. Study shows (Richards's table) that 10 tons is the minimum weight that should be removed from a cut, since dumps usually contain pieces 8 in. in diameter. If larger pieces are present, or if the dump be other than low-grade material, the weight of the sample must be increased accordingly. Judgment and experience determine the number of cuts required and all material must be reduced in accordance with the figures given in Richards's table, to provide individual samples from each cut. Taking every fifth or tenth shovelful and rejecting the remainder of the material is to be condemned, as obviously the individual particles are not small enough to permit cutting the sample at this stage in the operations.

There are other pitfalls that the engineer must avoid. In some assay offices, the practice is to grind through 100-mesh screen and to take one half or one assay ton of the pulp for assay. Complete decomposition cannot always be effected if fusion is attempted at that mesh; because 200 mesh is sometimes required for some ores. Duplicates should be run in important samples, and if they fail to check it is probable that finer grinding is required.

A sample of hard dark quartz was submitted to an assay office. The engineer submitting the sample requested that duplicates be run. Fusion was made at 100 mesh. The results did not check. A second and then a third set of duplicates were run without obtaining results that checked. The pulp was then ground to pass a 200-mesh screen, with the results as follows:

1st fusion at	100 mesh	No. 1	$3.80
		No. 2	4.20
2d fusion at	100 mash	No. 1	4.80
		No. 2	5.50
3d fusion at	100 mesh	No. 1	5.00
		No. 2	5.25
4th fusion at	200 mesh	No. 1	7.00
		No. 2	7.00

Telluride ores, if not recognized as such, may be the occasion of serious assay error. This ore being difficult to decompose, the gold is lost in both the slag of the fusion, and also absorbed by the cupel. Here is another instance when a duplicate fusion would probably show discrepancies that could be traced. Finer grinding and special methods of fluxing will give reliable results.

A difficult assay is one in which the sample contains free gold—even low-grade ore containing the metal in this condition. On these samples a one-ton charge will not yield reliable results. The safe method is to take 20 to 30 assay tons and amalgamate the free gold with mercury, which is recovered by panning. The tailings, after panning, are dried and assayed, and the mercury is dissolved in nitric acid and the gold recovered, subjected to inquartation, parted, and weighed. From the weight of the ore amalgamated, together with the weight of the gold recovered by this process, and the assay of the tailings, the value of the sample can be computed. The engineer dealing with unfamiliar ore should always carry out this test on important samples.

It is not to be expected that the commercial assayer can execute the correct method of sample reduction for a price of $1 to $1.50 per sample, commonly the standard price. A charge of $3 would be reasonable for reducing and assaying a 50-lb. sample. Competition in some instances has forced prices so low that any assayer asking such a price for his services would be forced out of business, but if engineers insist on taking advantage of the assayer's necessities, they must guard against haphazard methods and results.

PHOSPHATE
The Vital Non-Metallic

II—Continuing the travelogue of the Florida pebble field—The operations of American Cyanamid Company and Southern Phosphate Corporation

A. H. Hubbell
Associate Editor

Stripping at American Cyanamid's Oak Ridge mine. The dragline has a 165-ft. aluminum boom, the only one built of this metal in the pebble field, and a 10½-cu.yd. bucket, the largest in the field. Here the overburden, 40 to 47 ft. in depth, is the deepest that is being worked in the pebble field. The procedure is also unique for the district, stripping being done by first cutting a bench 25 ft. deep and 90 ft. wide in a 160-ft. cut, as told in the text

▶ THE FIRST ARTICLE *of this series, published in "E.&M.J." for September, 1940, portrayed the relationship of phosphate mining in the Southeastern United States to the fertilizer manufacturing industry, by way of background for the story of a trip made through the producing fields of Florida and Tennessee a few months ago by the writer. It told of the increasing utilization of lower and lower grades of phosphate raw material, at the same time that attention is being directed toward making fertilizers and intermediate products of higher phosphorus content, culminating in the large-scale production of elemental phosphorus in the electric furnace. Then, taking up the travelogue of the trip, it sketched a picture of the Florida pebble field and described the principal features of the operations of International Agricultural Corporation, as seen on this visit. In the current article, the story is continued.*

FOR YEARS the American Cyanamid Company has been an important producer of phosphate in the pebble field, operating through its subsidiary, the Amalgamated Phosphate Company. This subsidiary was dissolved about a year ago, without interruption in mining and washing operations, which have continued under the parent company's name. The local headquarters are at Brewster, where the manager, Harry L. Mead, resides. Mr. Mead proved himself an interesting guide as well as an entertaining host.

American Cyanamid's present operations comprise mining and washing at two mines and running a flotation plant and dryer, requiring a total force of approximately 250 men. For 25 years the company worked a mine at Brewster, a low-grade property no longer operated. The drying plant, however, remains at Brewster. It is equipped with Schofield kiln dryers, used by several other operators.

Today, the two mines worked are the Oak Ridge, and the Old Colony property 6 miles south of Fort Meade. We visited the former, which was opened two years ago. It is here that the deepest overburden in the pebble field is being stripped. At the time it was running 40 to 47 ft. in depth, with 12 to 20 ft. of a medium-grade, or 72 per cent, matrix underneath.

Stripping was being done with a Bucyrus dragline equipped with a 165-ft. aluminum boom, the only one in the pebble field, and a 10½-cu.yd. bucket. Originally the machine had a 137-ft. steel boom and a 7½-cu.yd. bucket. The aluminum boom was built especially. At first, it was riveted, but the members could not be kept tight, so the rivets were gradually replaced with steel pins 3/64 in. oversize, remedying the difficulty. The 10½-cu.yd. bucket is built of alloy steel and weighs less than the 9-yd. bucket that came with the machine. This bucket, according to Mr. Mead,

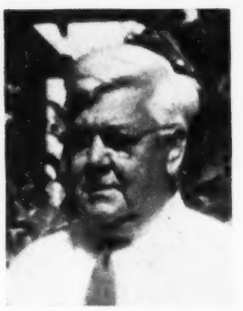
is likewise the largest in the district.

In working, a cut 165 ft. wide is taken. The stripping is done by first cutting a bench 25 ft. deep and 90 ft. wide. The dragline then attacks the bench. In its new position it is 25 ft. lower and, the slope being 1 to 1, the machine is 25 ft. further over, facilitating the disposal of the extra amount of overburden. One result is that stripping piles are more uniform.

At the Oak Ridge washer the feed is split into two parts for treatment in duplicate units. In each unit a trommel removes coarse mud balls. Flat stationary screens remove the water from the trommel undersize and much of the clay and fine sand that then go to waste. Further water and fine sand are removed from the flat-screen oversize on a 14–20 mesh single-deck vibrating screen, the dewatered product passing to a log washer that overflows mud and fine sand and makes a rock product. Both log products pass over single-deck vibrating screens, the oversize going to another log, the overflow and rock product of which also pass over vibrating screens, these giving the rock its final screening and washing. Final oversize goes to the wet bin and is loaded into cars. All screen undersize goes to a sump, thence to an Allen cone, the undersize of which goes to three pocket Fahrenwald sizers which make a washed fine rock product.

The Southern Phosphate Corporation, whose properties were next visited, has had an active year. Its president is Chester A. Fulton, who has contributed much to a clearer understanding of the technical and economic problems of the pebble operators, both in his interesting paper, already mentioned in Part I of this series, in the September issue, and in his testimony before the Joint Committee. E. A. Pierce, vice-president and manager, lives in Bartow, and it was he who arranged my visit, turning me over to C. N. Becker, assistant manager, who piloted me around.

Some 4½ miles west of Bartow, on the highway between that point and Mulberry, the company's drying and calcining plant, known as the Ridgewood plant, provides an interesting landmark. Here the offices also are situated. The company has three mines, only one of which is being operated. This is the San Gully, which with its washer and recovery plant, stands about 4 miles southwest of Lakeland. The other two are the Standard, also equipped with a recovery plant, and the Pauway, half mined out and lacking such facilities. In the two recovery plants agglomerate tabling is used for treating the phosphate rock. Flotation is not employed. With 209 men on the payroll the company had been working three shifts per day and six days per week.



Above, Chester A. Fulton, president of the Southern Phosphate Corporation, Baltimore. Right, E. A. Pierce, vice-president and manager, Southern Phosphate Corporation, Bartow, Fla. Above at right, C. N. Becker, assistant manager, Southern Phosphate Corporation, stands at the right of Harry T. Pierce, in charge of the company's San Gully mine and washing plant

Southern Phosphate's plant for drying and calcining is most striking, as the photographs show. The facilities provided for reclaiming from wet storage are exceptional. The reclaiming tunnel is built of reinforced concrete, 10 ft. high by 9 ft. wide and 440 ft. long. Every 10 ft. along the tunnel in the top, on the center line and right and left, are three chutes, projecting 10 in. and 10x10 in. in cross-section, each provided with an arc gate for feeding the two traveling hoppers above the 24-in. belt conveyor running through the tunnel. This belt is made of Duprene. It has a capacity of 150 tons per hour. It delivers to a similar 24-in. belt which runs at right angles to it and up to the top of the feed hoppers above the dryers.

Drying is done in a 60x6-ft. Allis-Chalmers single-shell unlined dryer and in a 55x7½-ft. Ruggles-Coles single-shell dryer, both revolving at 12 r.p.m. Both are likewise of the parallel-flow type, this company having been the first to use this type in the phosphate district, starting it in 1930. Bunker C fuel oil is used and the Bethlehem Dahl system of firing, giving a pressure of 200 lb. per square inch and 275 deg. F. at the burners. The entire plant has automatic interlocking control, including the belt in the tunnel. On each furnace there is a Clarage fan with a cyclone.

The two dryers jointly can handle 125 tons per hour, drying normally to 1 per cent moisture. They work on the same material and deliver to the same cross belt, made of asbestos. The chutes are housed for dust collection.

Provision for calcining is also made, the facilities consisting of an overhead 7x110-ft. Allis-Chalmers calcining kiln, with a 5x50-ft. cooler underneath running in the reverse direction. The cooler sucks in cold air counter to the flow of material. The kiln is lined with A. P. Greene's calcining kiln blocks, from Mexico, Missouri. This installation serves for making chemically pure, water-white phosphoric acid. Calcination temperature up to 1,750 deg. F. can be obtained. Six men per shift, including a foreman, are required for drying and calcination.

Dried rock is delivered to dry storage by a 19-deg. conveyor belt which discharges into the boot of an elevator at the bottom of the bins. The elevator raises it to the top, where it is distributed to the bins.

The dry bins, shown in an illustra-

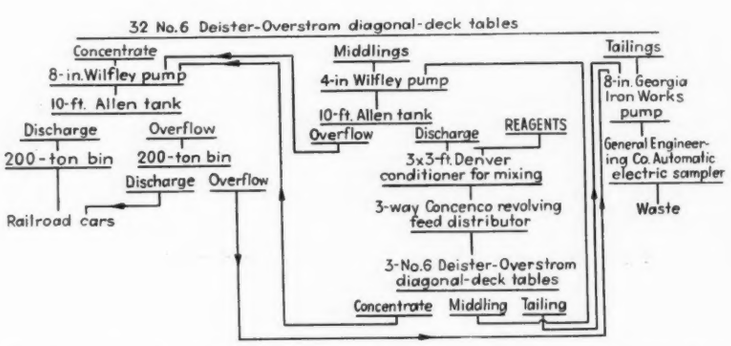
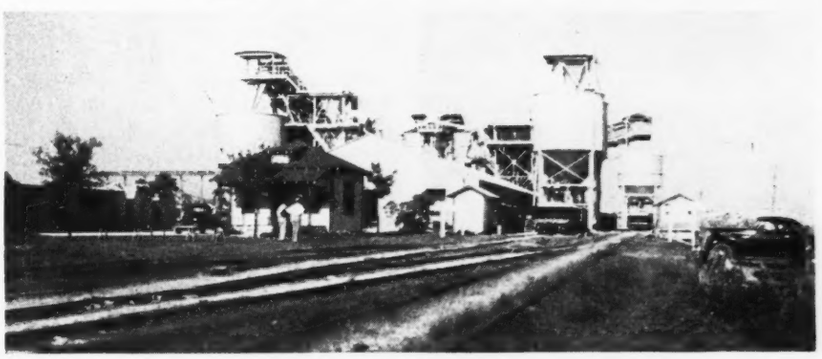


Fig. 4 . . . Flowsheet of that portion of the San Gully washing and recovery plant where phosphate sands are treated on concentrating tables after being oiled. Adapted from flowsheet in A.I.M.E. Technical Publication 881, by J. W. Pamplin

At Southern Phosphate Corporation's San Gully mine



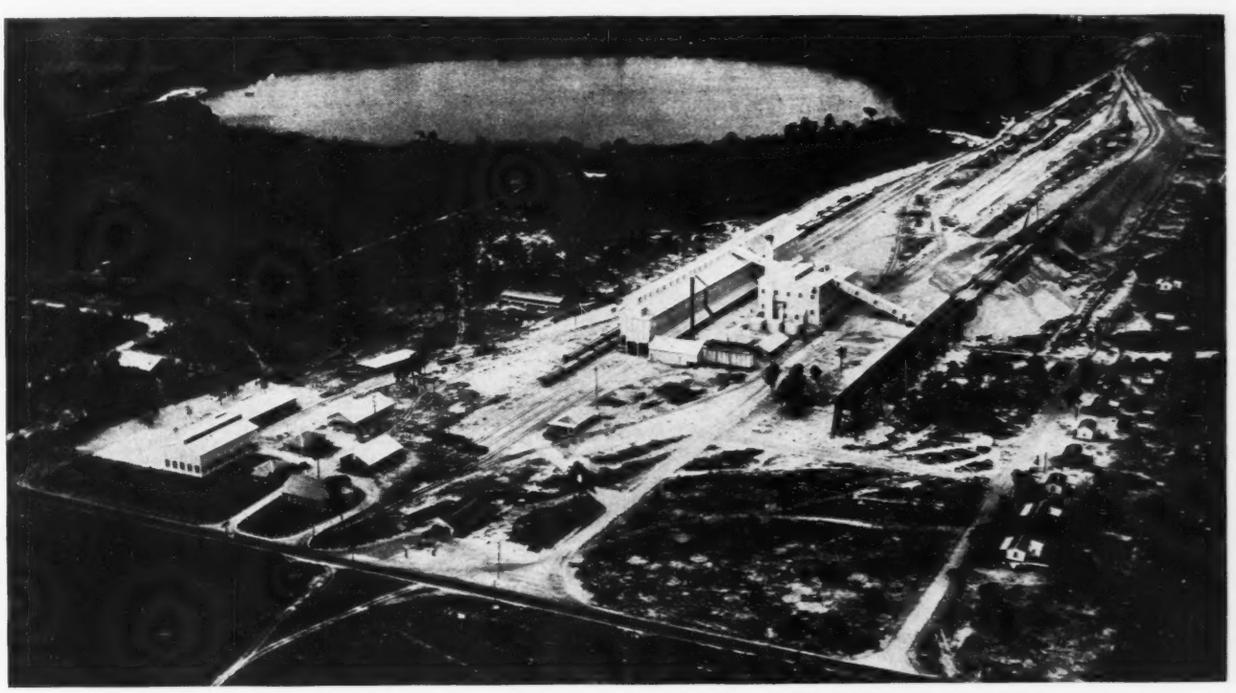
The San Gully washing plant of Southern Phosphate Corporation. In left center is the plant office

tion, are properly made of Florida cement and are built in three sections, each divided into four compartments of 2,000 tons' capacity, a total of 24,000 tons dry storage. Shipments of a wide range of analysis can be made up by grading with the material stored in these twelve bins. Top hatch cars are loaded by gravity through telescope spouts. A car can be loaded in seven minutes.

On driving over to the San Gully pit with Mr. Becker, I found Harry T. Pierce in charge. Here the overburden in recent weeks had been running 17 ft. in depth and the matrix 12 ft., with 15 per cent of recoverable B.P.L. A cut 210 ft. wide is taken. Stripping is done with a Bucyrus dragline having a 138-ft. boom and a 9½ cu.yd. alloy-steel bucket. Empty, the bucket weighs 12,500 lb. The gain in capacity, without increasing the gross weight of the bucket plus its load, is 1½ cu.yd., thanks to the use of alloy steel.

Mining at San Gully is done with two Georgia I.W. Climax guns using 2 to 2¼-in. tips and a tip pressure of 200 lb. The pit pump is a 12-in. Georgia unit with a 300-hp. G.E. induction motor. The matrix line is of 12-in. casing with peened flanges. Sixteen hundred feet away is the booster pump, a duplicate of this. The clear-water pump is a two-stage Allis-Chalmers unit with a 750-hp. motor. Mining is conducted in the usual manner. The only time the dragline ever digs matrix (instead of its being sluiced) is when room is needed for storing overburden, should this become deep.

Two deep wells are on the property,

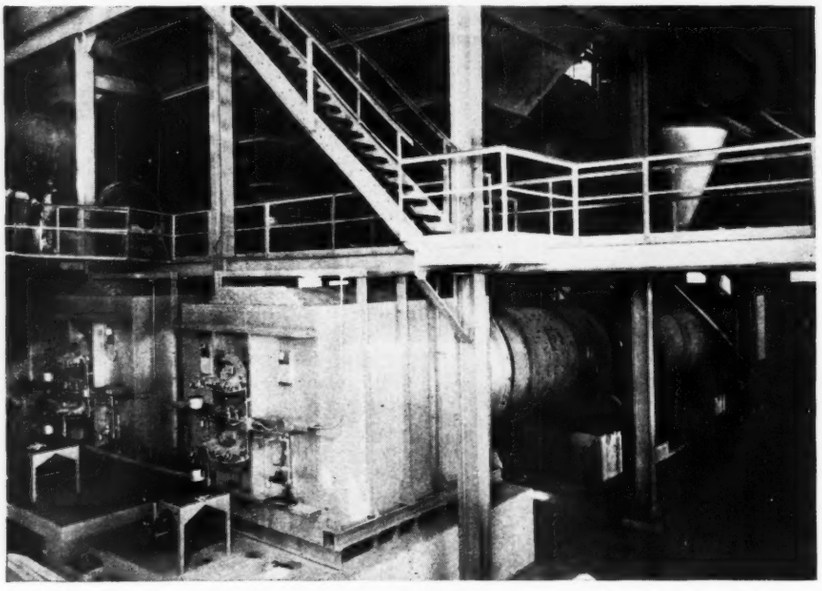


Aerial view of Southern Phosphate Corporation's drying and calcining plant at Ridgewood, Fla. Wet storage at the right

a new one 700 ft. in depth, used in the "dry" season, three months in the year, and an old well of similar depth. For both pit and plant 12,000 g.p.m. of water is required.

Power is received from the Tampa Electric Company's local substation at 33,000 volts and is stepped down to 2,300 volts by the Southern Phosphate Corporation.

Some time was spent in going through the San Gully washer and recovery plant with Mr. Pierce. Here it is the treatment of the phosphate sands on tables, after oiling them, that is of major interest. It so happened that J. W. Pamplin, metallurgist for the company, was away. He has, however, described the company's ore-dressing practice in detail in A.I.M.E. T.P. 881, published in 1938. In this paper he states that much work was done by the Bureau of Mines and by himself in 1932, independently at first and later jointly, on tabling the mixture of phosphate pebble and quartz in the minus-20-mesh sizes on the theory that "concentrating tables were more appropriate machines than flotation cells for such relatively coarse feed, would eliminate the slime losses due to grinding, and give a lower phosphate loss in the quartz tailings." Pilot work ensued which determined the design of both the San Gully No. 2 and the Standard washers. It is the San Gully plant that he describes.



Interior of drying and calcining plant at Ridgewood. This and the other accompanying pictures of the drying plant supplied by E. A. Pierce

In this plant the —20+65 mesh sands are treated on 35 No. 6 Deister-Overstrom diagonal-deck tables. That portion of Mr. Pamplin's flowsheet from this point on is reproduced (after redrawing) in Fig. 4. As he describes it, the sands are first delivered to two conditioners, where they are thoroughly mixed with the reagents, consisting of fatty acid (1½ to 2 lb. per ton of feed), light-gravity fuel oil (2 to 4 lb.), and caustic soda (½ lb.). He says:

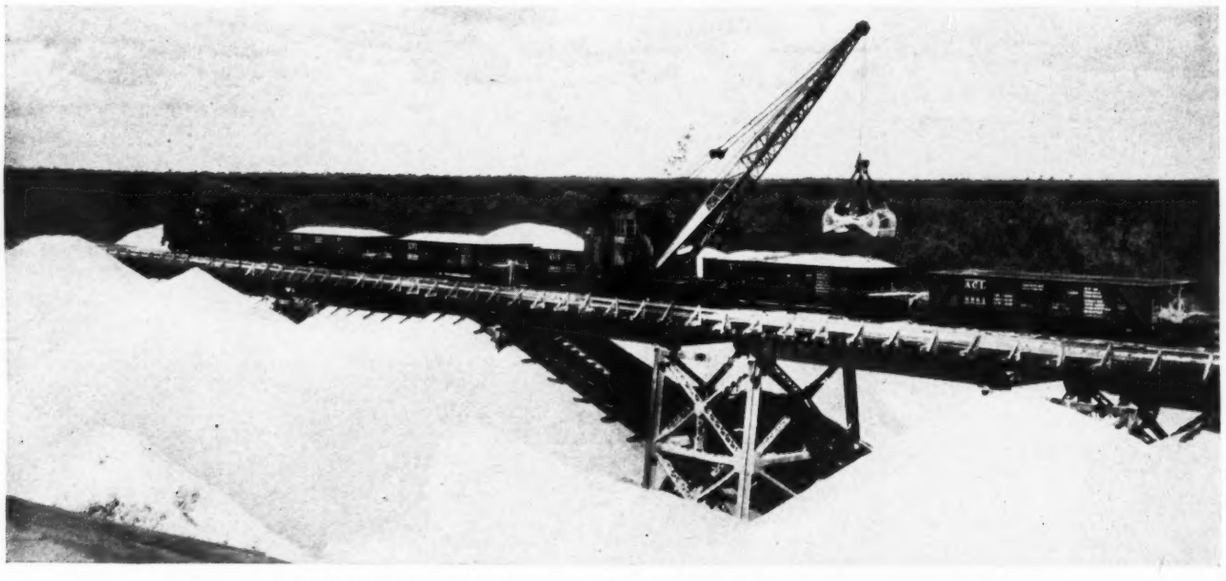
"The phosphatic sands are concentrated by oiling the phosphate particles to make air bubbles stick to them, then passing the oiled feed over regular ore-dressing tables. The oiled phosphate particles with air bubbles attached float over the side of the tables and away from the quartz. A middling is made, which consists mostly of unoiled phosphate particles and quartz. The middling is oiled in a separate conditioner, after which the phosphate is recovered on tables similar to those that treat the original feed."

Elsewhere he says:

"When the feed is tabled, the phosphate particles that were selectively oiled and agglomerated in the conditioners stratify on the tables on top of the quartz. After proper adjustment of the transverse slope and of the ore-dressing water, the phosphate washes across the riffles and discharges rapidly along the tailing side as a finished product. The quartz which is unoiled is carried to the concentrate end by the riffles and discharged as waste tailing. A middling cut of 15 to 20 per cent of the feed is made. . . ."

The product of this plant is sent to the Ridgewood plant for drying.

(To be continued)



Close-up of the facilities for unloading and storing wet phosphate rock at the Ridgewood plant

Mineral Concentration by Oil Adhesion in XVth Century

A selective process was apparently used in recovering lazurite

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FLOTATION and related processes are commonly regarded as contemporary developments. Unusual interest is therefore provided by the discovery of a manuscript of the fifteenth century in which details are set forth for the concentration by oil adhesion of lapis lazuli.

The manuscript was written by the Persian scholar Muhammad ibn Mansūr in the year 897 of the hegira (1491 of the Christian era) and is available in Istanbul, Turkey, as manuscript Aya Sofya 3611, together with several later copies.[1a] The manuscript is reproduced in the original script[1b] in a recent contribution from the Istanbul division of the German Archaeological Institute, with a translation into German.

The substance that is the object of the process is the blue mineral pigment, ultramarine, until recently much used for quality painting. The name of this pigment is lājiward; and lājiward is the word which has given us our word *azure* (via old French, *azur;* Arabic *lāzward;* Persian *lājiward*).

Muhammad ibn Mansūr makes a distinction between genuine lājiward and false lājiward. Genuine lājiward appears to be our mineral lazurite, the gem form of which is called lapis lazuli. Its best locality is in Badakshan, Afghanistan. False or second-rate lājiward appears to be our mineral azurite. Lazurite is a complex silicate[2] of the sodalite family containing sodium, calcium, sulphide sulphur, sulphate sulphur, and chlorine. It is, therefore, very different from azurite, the basic copper carbonate.

It is interesting to recall, also, that lazurite occurs exclusively in crystalline limestones[2a] and that azurite occurs frequently with a siliceous gangue. Thus it is seen that the problems of cleaning lazurite and azurite by adhesion processes must be, to quite an extent, the reverse of each other.

In the interpretation of the passages of the manuscript relating to purification of lājiward, the German translators of the manuscript believe that a flotation process is described. And since a carbonate mineral rather than a silicate would froth-float by the procedure described by Muhammad ibn Mansūr, Winderlich[3, 4] infers that the Persian scholar is mixed up as between azurite and lazurite. It seems, however, that the description refers, in the main, not to a froth-flotation or a bulk-oil flotation method, but to an agglutination procedure resembling those of Cattermole and Trent.

To evaluate the relative merits of this view and of that advanced by Winderlich, a direct translation of certain critical passages was prepared through the kindness of Professor George Sarton, Harvard University, by Mr. Aydin Sayili, one of his graduate students. Muhammad ibn Manūr says:

(I) "The washing of Badakhshī [lājiward] can be done in a few ways. One consists of boiling two equal parts of white and black pitch of Asia Minor in linseed oil until they get thoroughly mixed; then the mixture is cleaned [filtered] on linen cloth with a little clean water and it is ridden from pitches by washing it with hot water, then it is stretched like halwa [a sweet confection of rubbery consistency] until it gets white. Then pounded and pulverized lājiward is kneaded with it [the paste] and during one month this paste is kneaded or worked every once in a while; then it is washed with warm water in a glazed pot until three waters [aqueous suspensions] come out of it in succession. The first water [aqueous suspension] is very good, the second one is of medium quality and the last is of low quality.

(II) "Another way [of washing Badakhshī lājiward] is to use one part of gum-mastic and one half part of olive oil, brought to the right consistency on a slow fire. The sign of the right consistency is that when a drop of it [the fluid mixture] is dropped into cold water, the drop should not get excited [spread apart]* but remain together like a spot on the surface of water. Then pounded and pulverized lājiward and the above mixture are made together into a paste, and this paste is washed with water until three waters [suspensions] come out of it one after another. The first liquid is very good, the second of medium quality and the third liquid is the lowest in quality.

(III) "Still another way is the following: Two equal parts of resin of pinetree and of gum† [frankincense] are put in a white brass container; this is heated on a gentle fire long enough for it to melt. Then pounded lājiward is mixed with water and this paste is poured into the heated mixture of resin and gum. The whole thing is [then] stirred long enough until the lājiward gets thoroughly mixed with the rest. Then some cold water is poured in so that the whole thing freezes. Then the whole thing is melted and stirred again. If the lājiward comes out, then our aim has been obtained; if it does not come out, then a little olive oil or soap made from olive oil is mixed in, and the whole thing is poured into a glazed pottery container and is allowed to rest until the stones and dust which were mixed with lājiward settle out and until the lājiward comes and floats on the surface. Then the lājiward is removed from the surface.‡ In these operations about one third of the lājiward is lost.

Method No.	Reagents	Procedure	Products
I	Paste of pitch in linseed oil	Oil-ore agglutination, kneading and washing	Lazurite suspension in water; calcite agglutinate.
II	Paste of gum-mastic in olive oil	Oil-ore agglutination, kneading and washing	Lazurite suspension in water; calcite agglutinate.
III	Resin and frankincense supplemented by olive oil or soap.	Bulk-oil-flotation?	Azurite float; silicate suspension in water?
IV	Egg yolk	Oil granulation and decantation	Azurite granules; silicate suspension in water.

* This limitation shows that in this second method no bulk-oil flotation is desired.

† The word in the original text is best written in our notation as "Kundur" and may mean mastic, frankincense or juniper-gum. F. Steingass: Persian English Dictionary. Kegan Paul, Trench, Trubner & Co., London (1930)

‡ The text here clearly suggests that the lājiward has levitated to the top. The word "floats" is used, and it is the only place in the text that the word is used. We can have no assurance that the Persian writer used the word in our modern technical sense. We can therefore not decide whether froth flotation or bulk-oil flotation occurred; but we can be sure that something beyond mechanical suspension of the lājiward occurred. In view of the somewhat uncertain tone of this passage (*vide* the suggestion of repetition of the addition of olive oil) it is possible that Muhammad ibn Mansūr was referring to azurite, rather than lazurite.

(IV) "The washing method of the non-Badakhshi lājiward is that a paste of the pounded, pulverized and sifted lājiward is made with egg yolk. This is kneaded vigorously, and warm water is poured on it little by little so that it forms a broth [pulp]. Then the pulp is allowed to stand for an hour so that the lājiward may precipitate. Its water [suspension] is poured into another container. More hot water is poured on the precipitate, and it is worked; this is done three or four times, and the waters are all collected in a container so that any lājiward in them will precipitate. Then the precipitated lājiward is taken and the above-described process is repeated on it three times. Then water is poured on it so that the precipitate will be washed."

The accompanying tabulation is designed to summarize the methods described in the manuscript and my interpretation of them.

To assure the reader that Muhammad ibn Mansūr did differentiate between genuine high-quality lājiward (lazurite) and imitation or low-quality lājiward (azurite) it is pertinent to note that he contrasts treatment of Badakshī mineral with that of non-Badakshī mineral. This contrast is made in a categorical manner.

Of the azure minerals themselves Mansūr speaks as follows:

"Lājiward is a well-known soft stone. There are four types of it: Badakhshī, Kereji, Dizmārī, and Kīrmanī. The Badakshī lājiward has two classes; one of these classes has golden specks (dots) on it, the other does not have these specks. And, it is possible that lājiward is mixed with earth, dirt, dry mud or with a certain white stone."

The mining and geology of the Badakshan deposits has been presented briefly.[5] It confirms the existence of deposits of lapis lazuli, in the general locality indicated by Muhammad ibn Mansūr.

It is pertinent to note that v. Estreicher[6] took exception to Winderlich's interpretation of the old text, and called attention to an old work by Church in which a method is described that is used to prepare ultramarine water-color paints.[7] Church says:

"Some manufacturers adopt an old process, and make the powder into a soft mass with a little rosin, linseed oil and bee's-wax, and knead, beat, or macerate the lump under very weak potash, or soda-lye—the alkaline water carries off or withdraws the greater part of the pigment, and deposits it on standing. The richness of the blue product obtained depends primarily upon the original quality of the stone, but several grades are always procurable from the same raw material by means of the above-described processes, bluish grey and grey powders, known respectively as ultramarine ash and mineral grey, being the last and the least valuable products, while the deepest and finest pigments are deposited from the earliest wash-waters."

The resemblance between Church's description and that which preceded his by four centuries is startling.

In conclusion, it is interesting to note that the reagents used in the fifteenth century do not differ greatly from their modern counterpart. Evidently the following agents were used:

1. resin acids, fatty acids and soaps (pitch from Asia Minor, gum-mastic, gum, soap from olive-oil)
2. fatty-acid glycerides (linseed oil, olive oil)
3. pH regulation (use of soap from olive oil)

It is clear that selective oil-mineral adhesion was used, and it seems likely that the oil-adhering mineral was calcite in the first two cases and azurite in the last two.

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▼ ▼ ▼

Flame as an Indicator of Oxygen Depletion and Deficiency

Recent experimental work leads to some interesting conclusions

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OXYGEN DEPLETION is defined as any decrease in the normal percentage by volume of the oxygen present in the atmosphere. This normal percentage is close to 21 per cent. Oxygen deficiency is defined as a condition where the partial pressure of the oxygen in the atmosphere is too small to support life.

Oxygen depletion may be caused by the removal of oxygen from the air, or by diluting the air with gases. Oxygen deficiency may be due to either of these causes or to the lowering of the atmospheric pressure, the percentage of oxygen remaining normal. In this paper "percentage of oxygen" means percentage by volume. The danger of oxygen deficiency in the underground workings of a mine is always imminent.

Removal of Oxygen—Oxygen may be removed from the air by absorption by coal and by the slow oxidation of sulphide minerals. Surface water seeping down through the zone of mineral oxidation may become depleted of its dissolved oxygen, and this water dropping through the mine openings may take up oxygen and nitrogen from the air. As oxygen is more soluble in water than nitrogen, the air may become relatively enriched in nitrogen. The final results of the removal of oxygen and the dilution of the air with nitrogen gas from the rocks are identical.

Dilution—The gases that may enter the mine openings from the rocks and dilute the air of mines are methane, carbon dioxide, hydrogen sulphide, and nitrogen. It takes considerable dilution to affect seriously the oxygen percentage. If a mixture of normal air and some other gas contained 10 per cent of the abnormal gas, the percentage of oxygen would be 18.9 per cent. This depletion would be hardly noticeable at sea level.

If the diluting gas were methane, the mixture would be at the point of maximum explosibility, so a person in such an atmosphere would be in danger of being blown up and not of suffocating. Methane, however, if present in sufficient quantity, may cause oxygen deficiency. A miner wearing an electric cap lamp would have no warning of the danger.

If the diluting gas was carbon dioxide, the person breathing it would lose consciousness from the effects of the CO_2 and not from oxygen deficiency. The same would be true of hydrogen sulphide. If the diluting gas was nitrogen, the only effect at sea level would be to increase slightly the rate of breathing. At high altitudes with an already low partial pressure of oxygen a dilution of 10 per cent might be significant. In mines nitrogen mixed with a few per cent of carbon dioxide causes most of the dilution.

Certain processes simultaneously remove oxygen from the air and introduce diluting gases. Such processes are breathing, the slow combustion of coal, the burning of lights and explosives, and the decay of timber. The fungi that cause the decay of timber take in oxygen and give off carbon dioxide. It is always dangerous to enter old workings full of decaying timber without first testing for oxygen depletion.

Test for Oxygen Depletion—The simplest and most usual way to test for oxygen depletion is by means of a flame. As long as a flame burns at altitudes not far from sea level one is in no danger of oxygen deficiency. The flame test cannot be used if the diluting gas forms an explosive mixture before the oxygen is depleted sufficiently for the flame to be extinguished. Methane, for example, causes the flame to burn more vigorously until the methane is present in sufficient quantity to cause an explosion in the safety lamp. This explosion occurs long before the oxygen is low enough to cause extinction. The actual percentage of oxygen at which the flame is extinguished is not a fixed point but it varies with the character of the fuel, the temperature of the air, and the density and specific heat of the gases which sweep by the flame and tend to cool it.

M. H. Haddock (1924) gives the following minimum percentages of oxygen at which flames will burn: Candle, 16.9 to 17; coal gas, 11.5; and methane, 17.5. Many such figures exist in the literature, with no exact agreement because of differing conditions in the experiments.

In none of the discussions have we found any reference to the affect of barometric pressure on the extinguishing point, and so a number of questions presented themselves:

Are these percentages the same at high altitudes?

How does lowering of the partial pressure of the oxygen while maintaining the normal percentage of oxygen affect the flame?

In the endeavor to determine the answers to these interesting questions a number of experiments were carried out. A sheet-metal box with a 1 cu.ft. capacity, strongly braced to prevent collapse, with a glass porthole on one side, was constructed. From the chamber led tubes to a vacuum pump and a cylinder of compressed nitrogen. A disk fan was mounted inside with the shaft leading through a stuffing box to a motor on the outside. The purpose of the fan was to insure an even mixture when nitrogen was admitted.

The flame used was that from a cigarette lighter using ordinary lighter fuel. A spark plug was mounted with the points in contact with the wick. An induction coil, storage battery and switch on the outside completed the lighting assembly. A hot wire was tried but was found unreliable at low pressures. The lighter was covered by a screen to prevent air currents from blowing out the flame, which at all times could be observed through the porthole.

Effect of Lowering the Total Pressure—The first tests were made to determine the effect of lowering the atmospheric pressure. It was discovered that the lamp would burn at a lower pressure than that at which it could be ignited. The lowest pressure at which the lamp could be lit was 8.70 in. of mercury. This pressure corresponds to an altitude of about 30,000 ft. (All correlations of barometric pressure and altitude are from a table compiled by Harker and quoted by Leonard Hill (1920). Sea level is assumed as 30 in.)

After the flame was lit at this point the pressure was lowered still further and extinction occurred at a pressure of 5.90 in., which corresponds to an altitude of about 36,000 ft. The partial pressure of the oxygen at this point is 1.24 in., which corresponds to that in air at sea level containing a little over 4 per cent oxygen. It is thus apparent that the existence of a flame at high altitudes is not an indicator of oxygen sufficiency.

As the pressure is lowered the flame grows smaller. At 21,000 ft. the yellow color decreases and the flame appears detached from the wick. At 30,000 ft. the flame is blue and still farther detached from the wick.

Effect of Dilution at Various Altitudes—The next experiments were carried out to determine the effect of dilution of the air with nitrogen at pressures corresponding to various altitudes. Experimental procedure was as follows:

The chamber was evacuated to a desired pressure, which was noted. Then the wick was ignited and nitrogen admitted and mixed with air until the flame was extinguished. The pressure in the chamber at the extinction point was noted and the oxygen percentage calculated from the pressures. The percentages determined are a trifle high, because a small amount of oxygen was consumed by the flame during the time that the nitrogen was being admitted.

At a pressure equivalent to that at an altitude of 23,900 ft. the flame was extinguished at an oxygen percentage of 17.9 per cent. At a pressure equivalent to that at an altitude of 1,500 ft., the flame was extinguished at a percentage of 17.4 per cent. Percentages for intervening altitudes lay between these two figures. It is thus seen that the oxygen percentage at which the flame is extinguished by dilution does not vary greatly with the atmospheric pressure.

Practical Considerations — Dill (1938) studied Chilean miners at an altitude of about 19,000 ft. and found them able to do hard work. This is the highest altitude which we have noted at which mining work is carried on. The partial pressure of the oxygen at this altitude is about 2.97 in. This partial pressure would be the same as that in air at sea level with an oxygen percentage of about 9.90, which would be considered extremely low. Physiologically, the two conditions are not exactly comparable, because, as pointed out by Hill (1920), "Diffusion is far freer in rarefied air."

At low altitudes a low partial pressure of oxygen would have to be caused by excess nitrogen, and this fact, coupled with the high total pressure, makes a low oxygen pressure less bearable than the same oxygen pressure at a high altitude.

By remaining for a long time in these rarefied atmospheres a subject becomes acclimated, but equilibrium is gained slowly. Sudden changes may cause difficulties.

At the altitude of 19,000 ft. we know that the flame will burn with the oxygen depleted to 18 per cent. A miner entering a place with this depletion would be suddenly confronted with a decrease in the partial pressure of his oxygen of about 14 per cent, which decrease might result in an oxygen deficiency for the individual.

Conclusions

With the normal percentage of oxygen in the air, an oxygen deficiency due to increase in altitude up to 36,000 ft. cannot be detected by the extinguishing of a flame.

At altitudes where men live the combustion is dependent on the percentage of oxygen in the air and not on the partial pressure of the oxygen.

At high altitudes, with oxygen depletion, the assumption that continued burning of a flame is evidence of oxygen sufficiency is not warranted, but its behavior is an indication.

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Operating a Custom

Flowsheet of 300-450 ton plant of North Camarines

CLAIMS and surface plant of the North Camarines Gold Mining Company are situated about 1 km. southwest of Paracale, in Camarines Norte, which is in southern Luzon, in the Philippines. Paracale is at tidewater on the Pacific and is accessible by road, by air, and by small boats. No boat cargo is handled here, however. The district is well covered by roads, and the main provincial arterial highway connects with the Manila Railroad at Sipocot.

Heavy cargo is lightered from ocean boats to a jetty on Mambulao Bay and is trucked over suitable roads. Concentrate is moved by truck to the local smelter at Jose M. Panganiban, on Mambulao Bay.

Weather observations made at Daet indicate that normally the minimum rainfall is experienced in April and the maximum in November. The southwest monsoon occurs from June to September inclusive. The northeast monsoon is prevalent for the rest of the year, except for variable winds in May and in part of September and October.

Power is generated at the company's diesel plant of 1,790-hp. capacity. Current is made at 440 volts and transmitted at 2,300 volts by a tower line to the mine and mill transformers. Mine and mill power circuits are 440 volts, 3 phase, and 60 cycles.

The principal gold quartz veins of the district occur in an intrusive granite mass. The orebodies are practically all confined within this granite in mineralized cross joints hugging the soft schist cap that the granite intrusive has shoved upward. However, at North Camarines, small lenses of ore occur in some vein structures, due to apparent trapping of solutions with pinching of the veins.

Chalcopyrite, sphalerite, galena, arsenopyrite, and tetrahedrite are the principal sulphides. The principal gangue mineral is quartz. Often several periods of mineralization can be observed, with the quartz varying from greasy to vitreous; the younger the quartz, the more glassy the appearance.

In general the vein dip varies from 65 deg. to vertical. Very narrow veins are mined by shrinkage stoping. In sections of greater fracture and weaker walls rill stoping is used. But most of the veins are narrow, with small gouge zones on both sides between strong granite walls. Ratio of development footage to tons mined is high because of the narrowness of these high-grade veins.

The mill flowsheet was determined from the results of test work conducted on mine samples by three independent laboratories. Results indicated that amalgamation, gravity concentration, flotation, and cyanidation would be beneficial and economical. With one exception, milling practice in the district has been confined to amalgamation, flotation, and gravity concentration.

Upper levels of the mines in this district show variable quantities of copper sulphide minerals. Considerable test work was done to ascertain the effect of cyanicides, such as copper, and to determine the feasibility of rejecting the primary slimes. Among the findings (1) rejection of barren solution because of fouling was found unwarranted; (2) potassium ferrocyanide decreased in amount with an increased agitation period; (3) potassium sulphocyanide increased in amount with an increased agitation period; (4) consumption of lime and cyanide was found to be normal; (5) the possible effect of auriferous arsenopyrite on the final tailing was noted; and (6) the feasibility of discarding the primary slimes was noted.

The mill was designed to treat 300 tons of ore per day. Provision has been made for additional units. Operating conditions indicate that the design is adequate for handling 400 to 450 tons of ore daily. Provision also was made in the design for treating the ores individually if their characteristics should change in the future.

The mill buildings were framed from local lumber and covered with galvanized iron sheeting. Good lighting and ventilation facilities were provided.

In design and flowsheet, the plant represents the most modern custom milling facility in the Orient.

The mill buildings are four in number—namely, the crushing plant, the main milling plant, the precipitation, concentration, amalgamation, and refinery plant, and the lime and cyanide mixing plant.

Crushing Plant—Mine ore deliveries are accepted from the shipper's trucks and mine cars, and dumped on to grizzlies having bars set 9½ in. apart. Oversize is broken by hand and goes to the coarse-ore bin, which consist of one 500-ton bin divided into four compartments, three of 100 tons' capacity and one of 200 tons. Five automatic feeders pass the coarse ore through steel chutes to a series of two belt conveyors and a 24x30-in. primary crusher, set to 3½ in.

The 3½-in. crushed product is conveyed to the head of a 60-in. roller type washing screen, where tramp iron is removed by a magnetic pulley. A high pressure is maintained on the washing spray within the screen. The minus-⅝-in.-ring undersize flows by gravity to a classifier where sands and a primary slime are made. The slime overflow is sampled automatically and measured at 10-minute intervals in a tonnage box and is pumped to two dewatering thickeners in the cyanide section. Screen oversize falls on to a 30-in. picking belt moving at 112 f.p.m. The waste is mainly granitic wall rock, in large pieces. It is removed from the picking belt by girls and thrown

(*Continued on page* 49)

Panorama of municipality of Paracale with North Camarines Gold Mining Company's property at right and Pacific Ocean on left

Mill in the Philippines

Gold, at Paracale, in Luzon, combines amalgamation, cyanidation, flotation, and gravity concentration

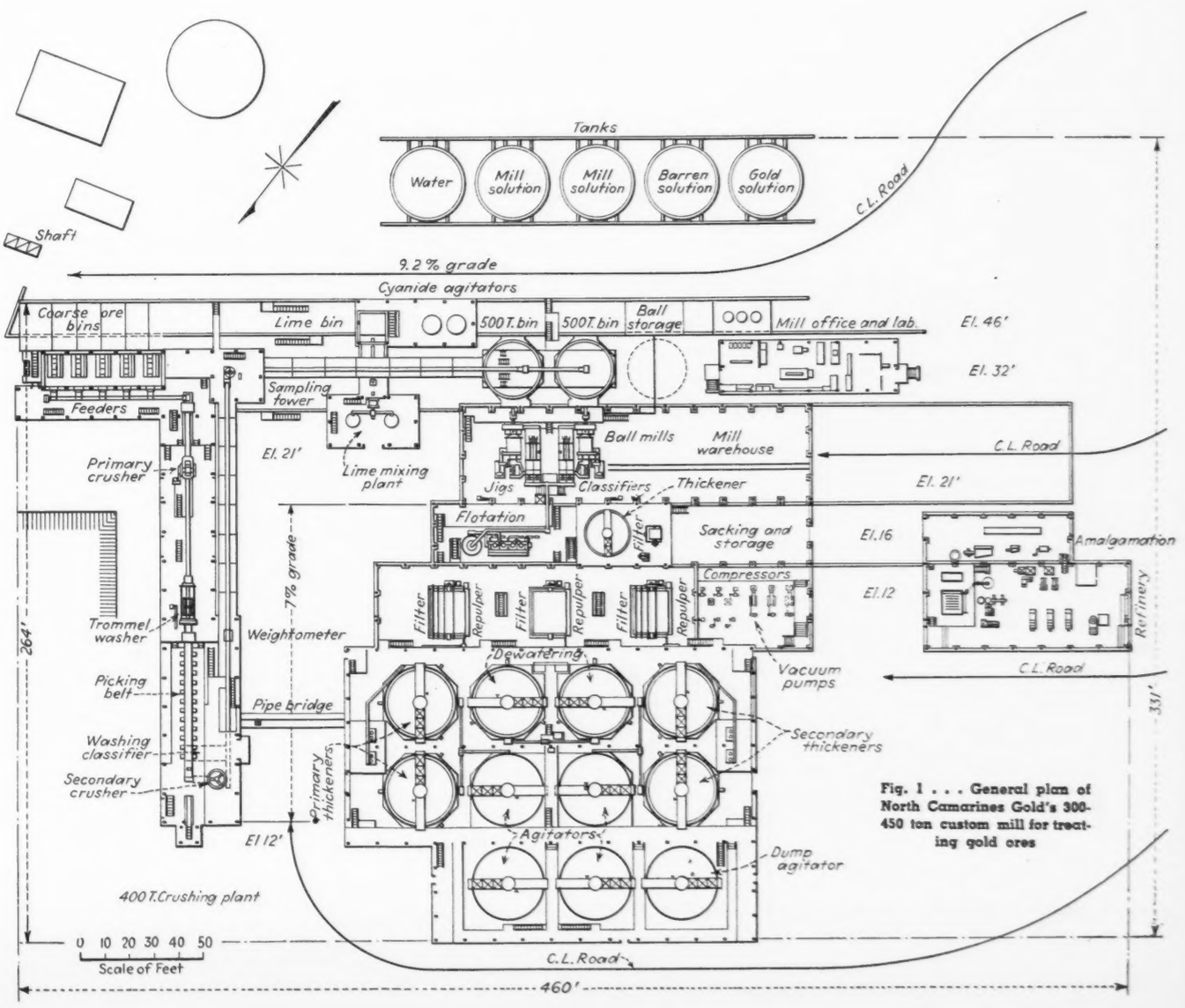


Fig. 1 . . . General plan of North Camarines Gold's 300-450 ton custom mill for treating gold ores

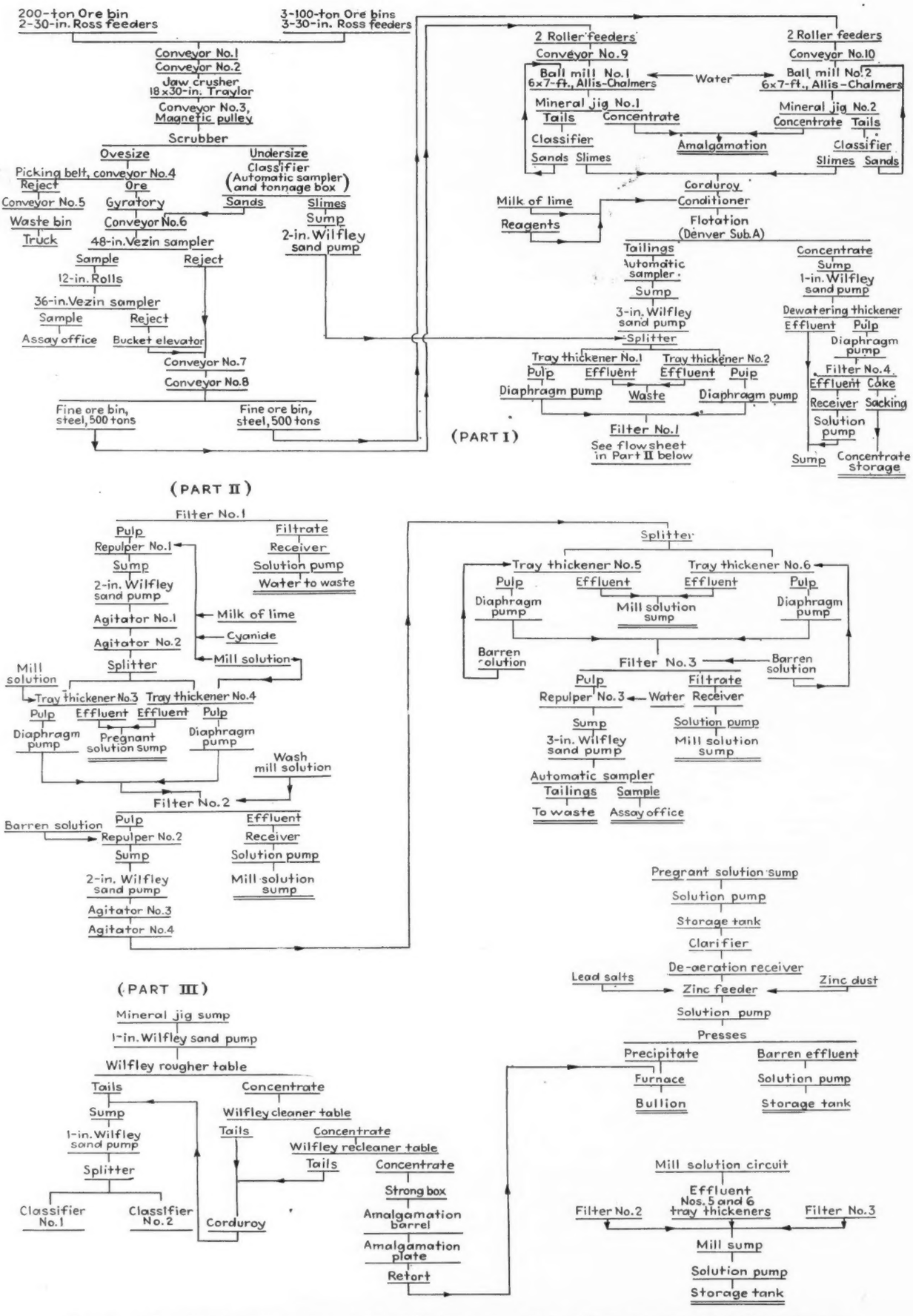


Fig. 2 . . . Flowsheet, in three sections, of the 300-450 ton custom plant of North Camarines Gold Mining Company

(*Continued from page 46*)

into metal chutes. From these it is conveyed to a calibrated pocket, sampled, and trammed to a dump.

Ore from the picking belt passes over a grizzly with ¾-in. spacing. The oversize is crushed to ¾ in. in a 3-ft. gyratory and is combined with the classifier sands and grizzly undersize on the same conveyor. The combined crushed products are then weighed and sampled.

Weighing is done on a weightometer and the sampling in a sample tower equipped with a primary 48-in. Vezin cutter, a set of 12-in. rolls, and a secondary 36-in. Vezin cutter. The minus ½-in. crushed ore samples represent 0.25 per cent of the total crushed ore and are dryed in an electric oven. Further reduction is done manually. Customary practice is followed in submitting samples to shippers. Sample rejects are elevated to the fine-ore bins with the rest of the crushed ore. These bins are two 500-ton steel silos with two outlets per bin.

Crushing plant capacity ranges from 40 to 70 tons of ore per hour and is governed by the slime content of the various ores. The plant operates 8 to 10 hours per day. All spillage drains to a sump provided with an automatic float. From this sump a pump delivers the material to the dewatering classifier.

Ores from shippers are combined in the fine-ore bins, where their identity is lost. In mineralogical composition the various ores delivered are similar at the time of writing and they are given the same treatment.

Of the crushing plant products, rejected waste constitutes approximately 12 per cent of the mine ore receipts, primary slimes sent to the cyanide plant, 11 per cent, and crushed ore sent to the fine ore bins, 77 per cent.

Grinding—Crushed ore from the fine-ore bins is fed by four automatic roll-type feeders on to two conveyors. These run to the main milling plant, each through its respective gallery, and deliver the ore to the ball mills. Ball-mill feed is regulated at the feeders. Single-stage grinding is practiced, the units being independent.

Two 6x7-ft. overflow-type ball mills are driven at 27 r.p.m. by 125-hp. motors through speed reducers. Mill water is used for pulping. The grinding media are 3½-in. and 4-in. forged-steel balls.

The ball-mill product is approximately 70 per cent solids. In closed circuit with the mills are two 16x24-in. diaphragm jigs and two duplex classifiers. The classifier sands return to the ball mills, and the overflow at 16 per cent solids goes to corduroy strakes.

A typical screen analysis of the classifier overflow is as follows: plus 65 mesh, 7.3 per cent; plus 80 mesh, 2.5 per cent; plus 100 mesh, 8.2 per cent; plus 150 mesh, 11.9 per cent; plus 200 mesh, 10.9 per cent; and through 200 mesh, 59.2 per cent. Relatively coarse grinding is obtained with a high circulating load.

Crane service is available throughout the ball-mill floor level, and an area has been provided for an additional grinding unit.

Operating and Metallurgical Data, Basis May, 1939, Mill Operation

Normal tonnage treated per 24 hours	300
Maximum tonnage treated per 24 hours, May	413
Ratio of concentration	79.5
Kilowatts per ton of ore treated	24.6
Total connected horsepower	1,018
Total operating horsepower	888
Total standby horsepower	130
Cyanide consumption, KCN, lb. per ton	1.46
Lime consumption, lb. per ton	5.31
Zinc consumption, lb. per ton of solution	0.03
Mercury loss in oz. per oz. of sponge produced	0.04
Flotation reagent consumption, (Z-6), lb. per ton	0.021
Flotation reagent consumption, Aerofloat No. 31, lb. per ton	0.042
Flotation reagent consumption, pine oil, lb. per ton	0.042
Total ball consumption, lb. per ton	2.0
Liner consumption, lb. per ton	Unknown
Agitation period, hours	41.9
Settling area in thickeners, sq.ft. per ton per 24 hr.	6.6
Filter area, lb. per sq.ft. per 24 hr.	979.6
Filter vacuum capacity, cu.ft. per min. per sq.ft. of filter area	1.07
Per cent gold recovery by amalgamation and gravity concentration	42.2
Per cent gold recovery by flotation	30.9
Per cent gold extraction by cyanidation	15.4
Total gold extraction, all treatment	88.5
Tons treated per man-shift	3.33

Table Concentration and Amalgamation—The hutch product from the jigs is discharged to a sump and is pumped to another building for table concentration and amalgamation.

Rougher, cleaner, and recleaner tables deliver approximately 35 kg. of finished concentrate per 24 hours to a strong box. All concentrate tailings pass over corduroy strakes to a central sump box and are pumped to a dewatering cone above the No. 2 classifier, where the underflow returns to be reground and the overflow passes to the flotation tailings sump.

Finished concentrate is amalgamated every five days in a barrel amalgamator using rods for grinding media. Mercury, sal ammoniac, and lime are added, and the charge is ground for five hours and discharged on to an amalgamation plate. The tailings pass over two hydraulic traps to the central sump box. Clean-ups are worked by hand, the amalgam is pressed, placed in a vault, and retorted to sponge every ten days. All amalgamation and clean-up work is done in the presence of a foreman and a guard.

Corduroy Strakes and Flotation—The classifier overflow passes over 60 sq.ft. of corduroy cloth. This is washed every three hours in a box that is drained periodically, the material recovered joining the jig product. The corduroy tailings are floated.

The purpose of flotation in this flowsheet is to extract cyanicides, such as copper minerals, in a concentrate. Reagents are added to the corduroy tailing; the pulp is conditioned and sent to the flotation cells. Three cells produce a rougher concentrate that is cleaned in the first cell of the unit. Middlings return to the rougher cells. The copper concentrate is thickened and then filtered on a 5x4-ft. drum filter. This filter product is shipped by truck in bulk to a local smelter. The flotation tailings are cyanided.

Xanthate Z-6, Aerofloat No. 31, pine oil, and milk of lime are the reagents used. Lime serves to depress the pyrite. A concentrate high in copper and low in gold is desirable for shipping.

Cyanidation—The cyanide treatment may be summarized as comprising three-stage thickening, three-stage filtration, and two-stage agitation. The first stage of thickening and filtration is used solely for dewatering the flotation pulp.

All pulps and solutions flow by gravity to a general sump, to be pumped elsewhere in the circuit. All pumping, blowing, and vacuum equipment has been provided with identical standby units, respectively.

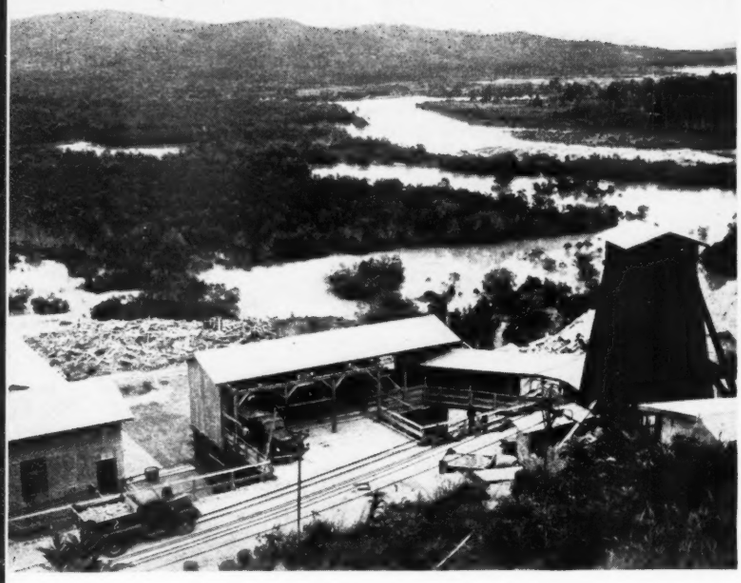
Flotation tailing is pumped to a splitter box with the primary slimes from the crushing plant, is sampled automatically, and distributed to two 30-ft. tray thickeners. The overflow goes to waste, and the underflow is pumped by two diaphragm pumps to a 14x18-ft. drum filter. The effluent goes to waste and the filter cake is repulped with make-up solution and mill solution to start dissolution. This pulp at 46 per cent solids is pumped to two 30-ft. agitators in series. The pulp then flows to two 30-ft. tray thickeners, where mill solution is added. The effluent is pregnant solution and is pumped to the head of the mill for storage.

Underflow is pumped by two diaphragm pumps to the secondary filter, where mill solution is used as a spray wash. The effluent is mill solution. The filter cake is repulped with barren solution.

This cycle is repeated again to produce mill solution from the thickeners. A barren solution and water wash are used on the tertiary filter for washing. The final cake product is repulped with water, to make a general mill tailing, is automatically sampled, and pumped to waste.

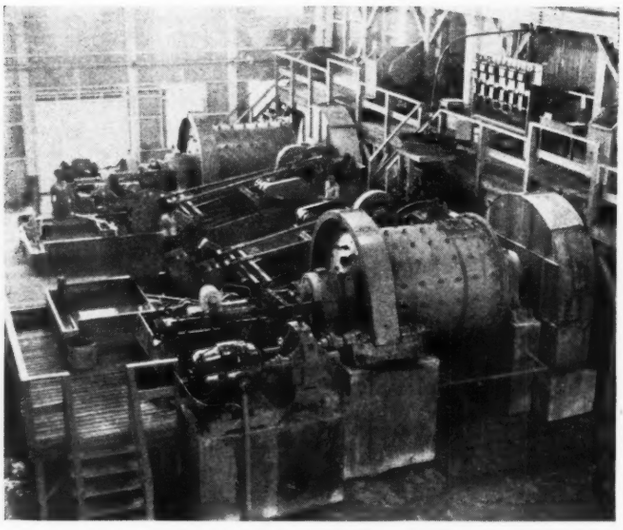
A standby agitator, 30 ft. in diameter, has been installed to provide for emergency storage of pulp during repairs to tank mechanisms.

Precipitation—The pregnant-solution storage tank feeds the clarifying tank by gravity. Eighteen 8x5-ft.

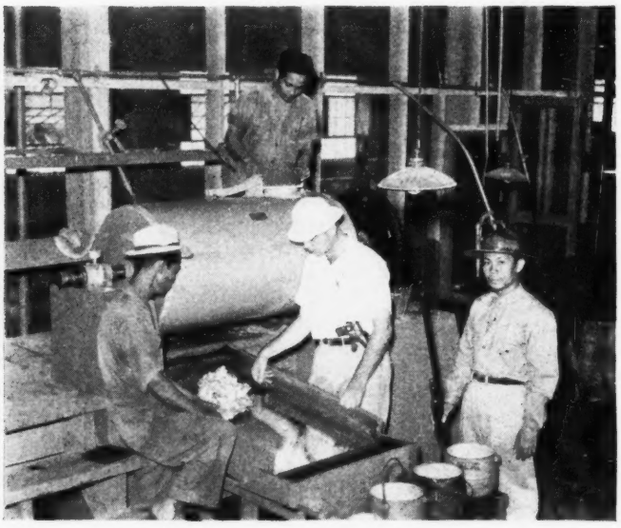


Shippers' trucks delivering ore to coarse ore bin of custom mill, with Salome headframe on right

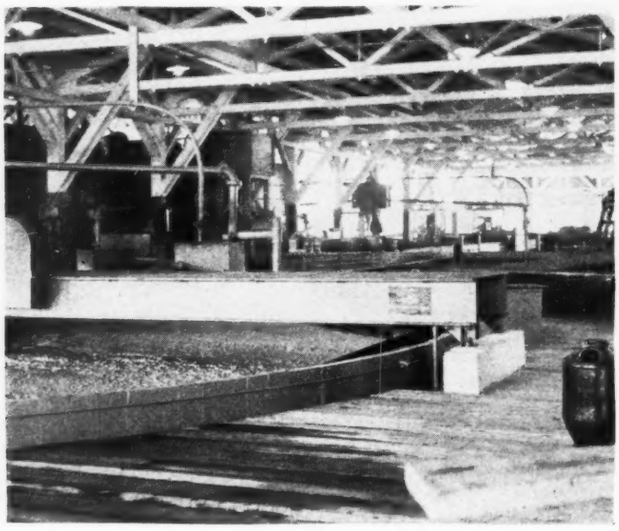
Ross feeders and conveyor No. 1 serving the coarse ore bin



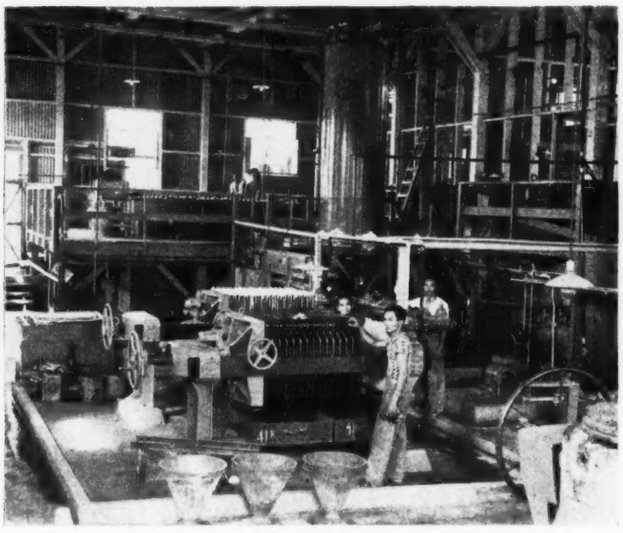
Single-stage grinding units, including jigs, in the custom mill. Dewatering cone in the upper right



Amalgamation barrel, plate, and clean-up. Finished concentrate is amalgamated every five days



Tray-like thickeners in the mill with distributing boxes and diaphragm pumps at right



Precipitation unit with refinery in foreground and concentrating unit separated by screen partition at the right

leaves with double sheeting bags are used. Six leaves are washed and precoated with Filter Cell every 24 hours.

Clarified solution flows to the de-aëration receiver and is de-aërated by an independent vacuum pump or by the mill vacuum system if necessary.

Zinc dust and lead nitrate are introduced into a mixing cone, and the zincked solution is pumped to two frame precipitation presses using 30x 30-in. sheeting and filter paper. One press acts as a standby.

Barren solution tonnage is measured by a meter and pumped to a storage tank.

Clean-ups are made every ten days by washing with water, drying with low-pressure air, and collecting the precipitate in pans in the usual manner.

Refinery—Precipitate, containing 15 to 20 per cent moisture, is fluxed with silica, borax, and soda, placed in paper bags, and added to an oil-fired tilting furnace using a No. 275 graphite crucible.

Cones are melted with sponge from amalgamation to make a finished bullion, which is shipped to the San Francisco Mint at 400 total fineness.

When the operation started and a low-grade precipitate was produced, the bullion was shipped to the local smelter. The amalgamation product was shipped direct to the Mint at San Francisco.

Lime Mixing—Milk of lime is made up daily by grinding burnt lime in a 3x3-ft. ball mill in circuit with a trommel screen. The grinding media are 3½-in. forged-steel balls. Feed to the ball mill comes from a bin by means of two conveyors. The pulp discharge is diluted and agitated in two 7-ft. diameter agitators. The screen oversize discharges to a box and is returned periodically for regrinding. Grinding is done with mill water. The agitators feed milk of lime solution to the flotation conditioner by gravity. Approximately two hours per day are required for grinding, and the agitation is continuous.

Cyanide Mixing—Aerobrand cyanide is added manually to two 8-ft. diameter agitators with mill water to make a solution of approximately 5.0 per cent KCN strength. Cyanide addition is completed on the day shift, and agitation is continuous. The agitators are provided with hoods and ventilation equipment.

The lime and cyanide mixing plants are situated at the head of the mill. Solution addition is made by gravity.

Conclusions—After six months of milling the following conclusions can be drawn:

General milling treatment by all processes indicates that the results obtained in practice equal, and in some cases better, those obtained in the test work.

The production of a low-grade precipitate in the cyanide treatment required careful attention in the refinery when the plant started.

Test work in the future will investigate the possibility of producing a copper concentrate for smelter treatment and a pyritic concentrate for cyanide reduction.

A maximum tonnage of 413 tons per day was treated during May, 1939. Treatment of more than the rated capacity of 300 tons per day affected the metallurgical and operating results but slightly. A slight reduction in tailing value can be produced by finer grinding at 300-ton per day capacity.

Shippers of ore are required to furnish ore test samples prior to accepting shipments. Classification in the laboratory is necessary to determine the adaptability to treatment in the mill. A questionnaire is then sent the shipper.

Acknowledgments — "Unusual Typhoons From 1903-1934," by Rev. Miguel Selga, S. J., Director, Weather Bureau, Department of Agriculture and Commerce, Commonwealth of the P. I.

N. C. Stone, engineer, North Camarines Gold Mining Company.

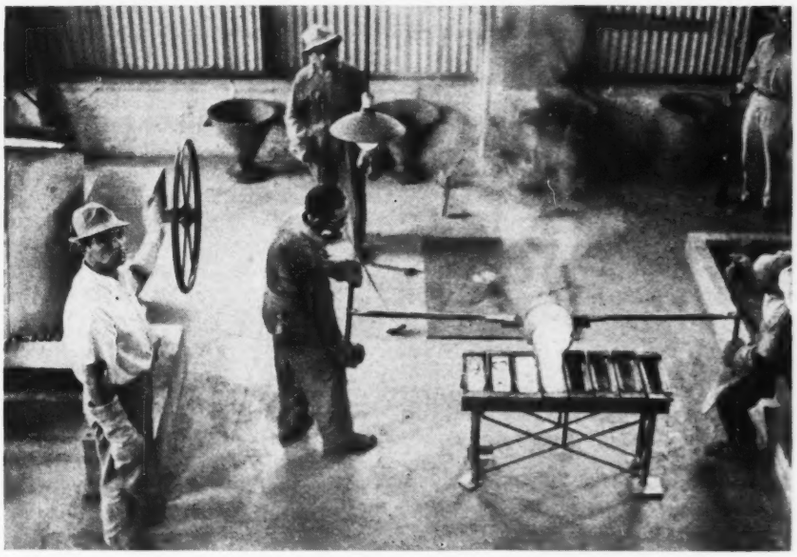
Abstract from test work by N. A. Fittinghoff and A. MacLaughlin, of the Masbate Consolidated Mining Company, Rio Guinobatan, P. I.

Abstract from test work by the Southwestern Engineering Company of the P. I., by L. L. Kirtley.

The general assistance of M. Barr, of Mambulao, and L. S. Taylor, metallurgist, North Camarines Gold Mining Company, is acknowledged.

Drawings and flowsheet are by courtesy of the erection engineers, Southwestern Engineering Company of the P. I., through E. R. Cullity, manager.

Photographs are by M. B. Ordun.



Pouring gold bullion in the refinery of the North Camarines company

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Chromite Mining in Jojohatu, India

AN AREA about 14 square miles of the hilly portion of Singhbhum, India, contains several villages where chrome ore is mined and supplied to the Tata Iron & Steel Company, Ltd.

In a paper by B. S. Bhaduria read before the 26th Indian Science Congress, Lahore, 1939, is described the general geology and types of chrome deposits that include boulder ore, reef ore, yellow reef ore, and the laterite ore.

At Jojohatu, the leading village, mining follows the exposed vein, by crude open-cut methods. Overburden is dumped into mined-out areas as soon as the depth goes beyond 70 ft. High and low explosives are used and holes are sometimes drilled within a foot of each other. Hand labor removes the muck and ore. During the rainy season mining stops, as there is no pumping. The life of a quarry usually ends in a year or two. Higher grade ore in depth is left behind as technique for mining beyond 70 ft. is absent, and costs rise. These deposits may be ruined within ten years if such crude methods continue.

The ore is hand sorted and cobbed by a small chisel-shaped hammer, ore averaging 50 per cent Cr_2O_3. Small pieces are crushed by a *durmut* on flat iron sheets. Panning of fine ore is also done, but the loss is great. The author believes mechanical concentration would provide 55 per cent Cr_2O_3.

Diatomite an Aid in Filtering Cyanide Precipitate

Pre-coating the papers in plate and frame presses with this earth facilitates the clean-up. Author develops a special technique for such use

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PRACTICES of operating and cleaning up plate and frame presses vary considerably, due to the differing characteristics of solutions and precipitates in the various plants. Some yield a precipitate that falls away from the filtering medium and accumulates in the apexes of the distance frames. The precipitate in other operations forms a coherent, impervious cake that clings to the filtering surfaces and causes back-pressure to build up rapidly. This last condition results in frequent clean-ups that are likely to be difficult and to involve undue handling of the precipitate when the presses are opened for cleaning. Every time high-grade precipitate is handled there is danger of loss, especially if the material is dried at any stage in the operation. Even when precipitate is recovered by washing cloths and the like in water, the material is exposed to incidental losses and theft. The best practice usually is that which accomplishes the clean-up with minimum time and manipulation.

A method is described here which was evolved in a plant that was undergoing rapid changes due to an expansion program. During the period of adjustment the filtering properties of the precipitate underwent a complete change. The plant was equipped with six 30-frame, 36-in. Merrill presses and during the period under description approximately 2,000 short tons was being precipitated daily. The practice was to dress the presses with 13-oz. duck over the plates. Precipitate was collected on paper, and to simplify its recovery if the paper broke, a layer of cheap muslin was laid over the duck backing. Gold solution going to precipitation had assayed from 7 to 9 dwt. per ton previous to the time when trouble with the filter presses started. With this grade of solution the major part of the precipitate was found in the apexes of the distance frames at clean-up time and press runs averaged two weeks. At the end of the run the back-pressure on the gold pumps rarely exceeded 25 lb. per square inch. The need for more washing solution in the plant made it necessary to increase precipitation tonnage, and the grade of the gold solution dropped to about half of its former value. The precious-metal content of the precipitate did not drop appreciably, but immediate trouble was experienced with excessive back-pressure in the presses after runs of three or four days. Not only were frequent clean-ups necessary but all of the precipitate was found in a thin, impervious layer on the papers that increased the time required to dispose of them by burning. Moreover, all of the precipitate was reclaimed in a dry, dusty condition which was undesirable.

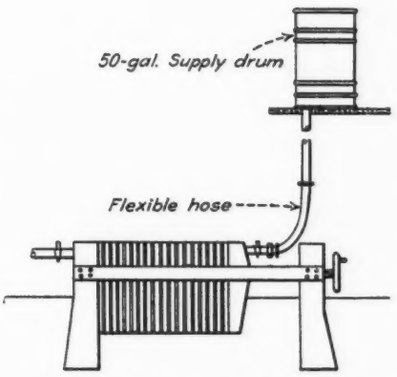
A supply of diatomite, or diatomaceous earth, known commercially as "Hyflo," was on hand, and the first step taken to relieve the condition was to add this material to the zinc mixing-cone at intervals with the purpose of forming a porous cake in the presses. This was unsuccessful and finally the equipment shown in the sketch was evolved for introducing the earth to the presses after they were cleaned and dressed for a new run.

Method of Pre-coating—The 50-gal. drum, shown in the accompanying drawing, which served as a supply tank, had an effective head of only 12 ft. It was therefore necessary to follow the procedure that I shall outline in order to obtain an even, effective coating on the filter papers. The press under treatment was first filed with barren solution from the supply tank through the bleeder connection. Half of the discharge spigots on the press were then closed, the valve on the bleeder connection was closed, and the supply tank was allowed to fill with solution. From 4 to 6 lb. of "Hyflo" were then stirred into the tank and the suspension was allowed to run through the half of the press with the open spigots. It was necessary to stir the contents of the tank continuously during the discharge period, because the earth settles rapidly. For this reason it is best to avoid long horizontal runs on the discharge line of installations of this kind. The discharge spigots on the press were then re-set and the other half of the papers were coated by the same procedure. Reasonable speed is required to prevent undue settling of the earth in the distance frames, and as soon as the last half of the papers are coated the flow of solution from the gold pump must be started. The speed of manipulation during the pre-coating operation determines the minimum amount of diatomaceous earth required. If too much is used or if the operation is delayed, the indication will be found in an excess of clean diatomite in the apexes of the frames at the subsequent clean-up. This of course serves no useful purpose except that of a flux for refining the precipitate, and local silica is always more economical for this purpose.

The practice of pre-coating did not increase the time of press runs, because the character of the precipitate was not altered. However, speed and cleanliness of clean-ups and earlier bullion shipments were made possible by taking advantage of the fact that the thin coating of the earth on the filtering surfaces allowed the precipitate to fall free from the filter paper during the clean-up operation.

Dressing Presses and Clean-up Routine—Previous practice had been to hang the canvas backing, muslin, and paper over the plates of the presses in the dressing operation. This was altered and the papers were hung over the frames instead. Then, during the clean-up the plates were slid along the channel supports to expose the paper hung over the adjacent frame. By reaching down, grasping the tip of the paper and giving it a quick upward sweep, most of the cake on the inner surface would fall into the receiving pans below. By sliding the frame along the channel and repeating the operation with the other side of the paper, it was possible to recover the whole piece with little precipitate adhering to it. This paper was put into a separate pan for subsequent drying and burning. On the average, approximately 20 per cent of the precipitate remained on the paper, but no difficulty was had in burning it quickly with minimum handling.

The presses were blown for an hour with air at 10-lb. pressure. This reduced the moisture content of the cake to about 50 per cent, in which condition the material collected in the pans under the press was in a suitable condition for fluxing. Flux to the extent of 60 per cent of the dry weight of the precipitate was mixed with the damp material, and the resulting mixture was briqueted, dried, and stored for subsequent melting. The dry ash from burning the papers was usually



Pre-coating of the papers in the press was effected by running a water suspension of diatomite from the supply tank shown into half the press at a time with the spigots open. The other half was then similarly treated

mixed with a subsequent clean-up of damp precipitate, although it could be dampened and briqueted alone.

Melting was performed in a simplex-type Monarch furnace. Direct melting produced a bullion of between 900 and 920 parts per 1,000, total gold and silver. A variable amount of matte was produced in the melting, and when a sufficient quantity of it had accumulated, it was reduced by melting with about 10 per cent of its weight of cast-iron turnings. The secondary bullion thus produced was mixed with primary bullion without further refining. The clean-up practice described in the foregoing was responsible for eliminating a full day from the shipment schedule of between 10,000 and 12,000 oz. of bullion, over and above the advantages gained from cleaner handling of precipitate.

Cleanliness—During the process of working out this practice, several steps were adopted to guard against incidental losses of precipitate and contamination of barren solution. It was necessary to acid-treat the canvas filter cloths on the presses after about ten days' use. The covers were not removed from the press until the clean-up was completed and all visible precipitate was brushed up. Unless this were done, it was found that bits of precipitate would lodge in the drainage channels of the plates and "salt" the barren solution for several hours after the press had been put back in operation. This precaution is an elementary one but may prevent a run of "high barrens" on clean-up days that is a common experience with operators. If there are facilities for returning the first effluent from the presses to the gold tank or mill sump for say 15 min., the average plant should suffer little from a routine clean-up.

Clean-up pans were placed on 25-lb. rails that ran through the base of the main end-plate castings of the presses. The height of the pans was designed just to clear the tips of the plates and frames, and, as a further precaution, canvas screens were hung alongside the press during the clean-up to confine the fall of precipitate to the receiving pans. By these means precipitate was kept off the floor completely. The clean-up pans were never used for any purpose other than that described. Separate pans were used for drying and burning filter papers, as this service warped them rendering them unfit for use under the presses.

In general one point to remember in using the system of pre-coating is that a stoppage of the gold pump, as from a power interruption, at any time during the run of a press usually causes the accumulated precipitate cake to fall free of the paper. Unless the press is pre-coated again within an hour or so after starting, it will be impossible to obtain clean paper at the clean-up.

Some experiments were made to take advantage of the fact that the cake would drop if the presses were "rested" for several hours. It was found that the extra weight of precipitate taken from the presses thus treated did not justify the extra trouble. In addition, the barren solution from the "rested" presses showed erratic assays which indicated that dissolution took place in the press for some time after re-starting.

Filter paper will stick to the frames of presses that are run for a week or more no matter how carefully the machined faces of the frames are cleaned. No sort of oil or grease seems to prevent this. However, pre-coating is an advantage even here because most of the precipitate will fall away from the paper if it is tapped on the outside surface before removal from the frame. It is essential in every application of this practice, however, that the papers be hung on the frames and not on the plates.

I have found the practice of pre-coating to be advantageous in several plants with filter-press installations. The apparatus is easily and cheaply made and the extra attention required in starting presses is more than repaid in the time saved later on. This especially applies in small plants where the superintendent is obliged to devote his time to the supervision of clean-up and melting. If, as is often the case, barren solution is not available at the head of the plant for an installation of this kind, clean water may be used in the supply tank for the presses. This tank should not be less than 10 ft. above the press, or an uneven coating may result.

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Manganese in Little Florida Mountains, New Mexico

A PRELIMINARY REPORT of work done by the Geological Survey in investigating the manganese deposits of the Little Florida Mountains, New Mexico, was recently released by the United States Department of the Interior. The survey was done in 1939, under funds allotted by the Federal Emergency Administration of Public Works for the investigation of deposits containing minerals of strategic importance. Described in Geological Survey Bulletin 1940, the report covers geology, production, and estimates of ore reserves.

The deposits lie long fault fissures that cut fanglomerates derived from underlying deformed Miocene(?) volcanic rocks, in the Little Florida Mountains near Deming, New Mexico. The ore minerals include manganite, psilomelane, pyrolosite, and wad, which were derived from original manganiferous calcite, largely black calcite. It is difficult to concentrate.

The Luna and Manganese Valley mines are the only ones that have been explored to any appreciable degree; therefore, estimates of proved and probable reserves refer largely to reserves at these two mines, about 75,000 tons of crude ore, representing between 15,000 and 20,000 tons of concentrate containing 40 per cent or more of Mn. The tonnage and grade of the concentrate will depend on the efficiency and method of beneficiation.[1]

The report states that should ore extend for any appreciable depth below water level, the potential reserves of the district may be increased to a significant degree. In view of this possibility and the meager exploration on the many other veins in the district, it is reasonable to estimate that the district may yield from 750,000 to 1,000,000 tons of crude ore, from which might be derived 150,000 to 200,000 tons of concentrate containing 40 per cent or more of Mn, the actual amount depending to some degree on the method of concentration that is employed.

Production costs at the Manganese Valley mine during the principal years of operation were about $7.50 per ton. Transportation costs on material shipped averaged $10.50 a ton, including $0.75 a ton haulage from the mine to the railroad.[2]

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[1] "Manganese, Its Occurrence, Milling and Metallurgy, Pt. 1." R. S. Dean and others, U. S. Bureau of Mines I. C., 6768, 1934.

[2] U. S. Bureau Mines Mineral Resources, 1928. Pt. 1, pp. 216–218, 1931.

The Milluni mill, where ton ore is concentrated by a gravity method and flotation. A property of the Hochschild group. Huayna Potosi is the snow-capped peak

Bolivia for Strategic Minerals

Production of tin, tungsten and antimony could be expanded, were capital made reasonably secure

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WAR IN EUROPE has brought home to the American people the fact that they are not yet sufficient in regard to certain necessary minerals. This has culminated in the "Strategic Mineral Act." The results of this act will eventually bring to light important mineral deposits; but it is doubtful if the new deposits will make the United States completely independent of all foreign mineral imports. Many of these "Strategic Minerals" are to be found in commercial quantities in the various Latin American countries to the south. American interest should not be centered entirely upon the United States, but should also include these other American countries. By so doing important sources of cheaper minerals may be developed, the purchase of which will assist in trade.

Tin, tungsten, and antimony occupy first, third, and fourth places among Bolivia's mineral exports, and in 1939 amounted to 81.5 per cent of Bolivia's total exports. Bolivia ships its minerals mainly from the Pacific coast, so that, should the United States become involved in war, they would be available either for its Pacific coast or for the Atlantic coast by passing through the Panama Canal. The development and control of these commodities should be given a place in the economic program of American industry. Table I shows the importance of the Bolivian mineral exports. (Page 58)

During the past decade Bolivia has been passing through a series of crises. The Chaco war and its aftermath of *de facto* governments and dictatorships, with their socialistic tendencies, have prevented new capital from entering the country and discouraged established industries from expanding their operations. The mineral industry has financed these governments and their experiments through the payment of heavy taxes and forced delivery of foreign exchange at an artificial rate.

By the election of March 10, 1940, were chosen a constitutional President and a Congress which is expected to show a less radical attitude toward mining, the principal industry of the country. A decree issued in the latter part of March, after the elections, removed one of the obstacles to mining when Article 12 of the decree of June 7, 1939, was modified. This removed the limit on dividends, which previously had stood at 5 per cent. Also, the new decree allows foreign engineers to be contracted abroad, their salary or fees being payable in foreign currency.

On Oct. 1, 1939, the tin industry received slight relief when a decree was approved which reduced the delivery of foreign exchange from 50 per cent of the sale price of the metal to a figure varying between 40 and 50 per cent, depending on the amount of tin exported. The concession did not include the other mineral exports. With the modification of this item, study of which is still before the Finance Minister, and the continuation in office of the liberal element, it is expected that the Bolivian mineral industry may advance rapidly.

Table II shows the relationship of Bolivia's production of the strategic minerals in the world market.

As production of tungsten and antimony reached a new high for Bolivia in 1939, it is logical to expect that her percentage in the world production also increased.

Conditions are favorable in Bolivia for the rapid expansion of the production of tungsten and antimony, and the return of the tin companies to capacity operations, if reasonable security is offered to capital.

Tin—Bolivian tin exports are controlled by the International Tin Cartel.

Table III shows the quota assigned, with the corresponding exports in metric tons of fine tin.

In 1939 the International Tin Cartel raised the production quota rapidly the last few months of the year. It was impossible for the Bolivian companies to step up their production from the 45 per cent rate, which had been in force for the preceding eight months, to full capacity overnight. If this action had occurred at the beginning of a calendar year, the companies would have had twice the time to reach capacity and thus would have been able to meet Bolivia's quota.

In the past Bolivia has not shipped its full quota, because of the effect of the Chaco war, through loss of manpower; and because of the socialistic tendency of the government, which removed the incentive to produce by levying heavy taxation.

Lack of manpower has gradually been overcome through the improvement in mining methods and installation of machinery, so that a workman can produce a larger tonnage per man-shift. With the return to power of a sympathetic Government, capital may be offered security, and it is logical to assume that the heavy taxes may be reduced. This should induce the various operators to step their plants to capacity operation, which would allow Bolivia to fulfill her quota easily in the international market.

Approximately 80 per cent of the Bolivian tin production is in the hands of seven companies.

It is doubtful if the companies listed in Table IV would undertake any new plant expansion at their present properties. Therefore the future expansion of the Bolivian tin industry is in the hands of the small miner; that is, small mines and new prospects must be developed if Bolivia is to maintain her position in the world's tin industry. These small mines generally work on a hand-to-mouth basis. As fast as ore is developed, they extract it, mill it in crude plants, and sell it to the local ore buyers so that funds will be available to continue. On such a basis, they never block out ore reserves, and, unless they encounter a rich high-grade pocket of ore, will continue indefinitely the existing procedure. Nevertheless, several of these smaller properties are installing small modern mills and within the next year they will step out of the ranks of the small producer.

Future of Deposits

Ore reserves of the individual mines vary greatly, depending on the ideas of the management. Some properties maintain reserves sufficient only for a few years' production; others maintain reserves many years in advance of production. It is generally believed that the properties of the seven companies tabulated have sufficient ore reserves for ten years' production. The geological conditions are such that an additional ten to twenty years life can be developed through intelligent prospecting and development work. Today production is that fixed by the International Tin Cartel, 80 per cent. The mines could easily meet this quota, and its production only awaits a clear indication that the new Congress will respect and protect the Bolivian mining industry.

Tungsten—Tungsten production began in Bolivia in 1908, when 168 metric tons of fine WO_3 was exported. Due to the high prices during the first World War, production was stimulated and reached 3,890 metric tons of fine WO_3 in 1917. The bulk of this came from the Chojlla, Enramada, and Pichu mines, situated on the northeastern flank of Muruata peak, near La Paz; the Chicote region near Oruro; and Cia. Aramayo's mine Tazna, near Atocha. After the war, with the drop in the price of tungsten, many of these mines were closed and some abandoned.

In 1929 the rich Conde Auque scheelite property, near Oruro, was discovered and Bolivian tungsten production again took an upturn, Conde Auque accounting for the bulk of Bolivia's 1929 production and that which was shipped during the next few years. Wolframite began to be recognized in other sections of the republic and in 1934 the tungsten industry again began its upward march, this time the advance being based on production from many scattered properties and not on that of one mine, as in 1929.

Wolframite is the principal mineral mined; the Conde Auque mines, which produce scheelite, account for only a small percentage of the present total Bolivian exports. Probably 50 per cent of the Bolivian exports are accounted for by the following four companies: International Mining Company (W. R. Grace & Company); Cia. Aramayo Mines de Bolivia; Bolivian Tin & Tungsten Mines Corporation; and Sociedad Empresa de Estano Araca. These companies have modern mills for processing the wolfram. They have undertaken comprehensive mine

Chojlla mine, showing the roasting furnace. The mine entrance is to the right of the rock slide

development work and could probably expand their production if conditions warrant. The remainder of the Bolivian production comes from small properties which have practically no equipment installed, and have been mining their easily discovered ore by hand, treating it in small, crude hand mills. The potential ore reserves of these smaller producers are large. Given adequate security and protection, the Bolivian tungsten industry could rapidly expand from 2,000 metric tons of fine WO_3, shipped in 1939, to 5,000 metric tons fine metal per annum or better.

The principal wolframite districts are, from north to south:

1. Sorata. Around Illampu granite batholith.
2. La Paz. Around the Illimani-Muruata granite batholith.
3. Araca-Quime. Around the Quimza Cruz granite batholith.
4. Chicote-Kami. Metamorphosed shales.
5. Conde Auque. Metamorphosed shales.
6. Tazna. Igneous intrusive.
7. Esmoraca. Andesite flow.

There are a few mines, quite small, that are situated in the shales which are producing an antimony-tungsten ore. Their production is, individually, not large. With the exception of the Conde Auque district, where scheelite is the principal mineral, the districts named are producing wolframite. A brief description of some of them will be given.

Bedding Plane Faults

La Paz District—The La Paz district forms a large semicircle from near Palca, on the La Paz River side extending along the northwest, northern, and northeastern flanks of Illimani and Muruata to near Yanacachi, on the eastern slope of the mountains. The Chojlla deposits, near Yanacachi, owned by the International Mining Company, which is controlled by W. R. Grace & Company, have received the most attention and in 1917 were responsible for a large production of wolframite. Today these deposits have been equipped with a modern mill and again are one of the most important Bolivian producers.

The occurrences are formal quartz veins, in shale, varying from a few centimeters to about 3 meters (10 ft.) in width. They strike about N. 40 W. and dip south at about 50 deg. Usually several veins are found as parallel structures over a width of about 50 meters (164 ft.). Bedding plane faults often displace the veins a few meters and a cross-fault system has displaced the veins some 20 meters (75 ft.). These faults complicate the development work, but offer no serious difficulty, once the problem has been solved.

The vein minerals, beside quartz, are pyrite, arsenopyrite, sphalerite, wolframite, and cassiterite in the order named. Usually the ore is found in pockets along some irregularity of either the footwall or hanging wall. Some of the pockets are of considerable size, producing several tons of pure wolframite, which is sacked in the stope for shipment. Generally the entire vein is mined so that any small wolframite masses will not be missed. The mine is now equipped with a 100-ton mill, a 200-kva. hydro-electric plant, a roasting furnace for removing the arsenic, and a magnetic separator for treating the wolframite-cassiterite concentrates.

The Chojlla area is developed by some six mines, which have exposed the mineralized belt over a vertical range of about 1,500 meters (5,000 ft.), with the lower limits of the commercial deposit not yet known, and for a horizontal distance of some 5 kilometers (3 miles). The tin content appears to be increasing with depth, the entire production of tungsten-tin concentrates coming from the lower mine. Although no granite has been exposed in the mine workings, it is probably quite close. In the El Barco mine the vein appearance suggests a pegmatite. Capacity of the plant has been increased from 40 tons of fine WO_3 to about 100 tons fine WO_3 monthly. The potential ore reserves of the Chojlla area are probably sufficient for a monthly production of 200 tons of fine metal.

Araca-Quime District—The Quimza Cruz granite batholith occurs south of the Illimani-Muruata batholith, being separated by the La Paz River. On the northwestern end of this batholith, at the granite shale contact, are found the Trascuarenta system ot veins. Although they were worked during the first World War, production was small, and it has been only within the last few years that active development has been undertaken. Unlike the Chojlla deposit, these veins cross from the granite into the shale, and development work is being actively carried on in both rocks. The veins average about 50 cm. (20 in.) to 1 meter (39 in.) in width, and assay from 1 to 25 per cent WO_3 across the full vein width. The gangue material is pyrite, arsenopyrite, and quartz, named in the order of abundance. The heavy sulphide content does not suggest a pegmatite, as at Chojlla.

At the Araca mill the wolfram concentrate is treated by flotation, which produces a clean concentrate assaying about 70 per cent WO_3 and carrying under 0.5 per cent As. Production is small, as the development work has been under way for only about two years.

On the southeastern side of the range similar deposits are being worked near Quime and Caracoles. The entire district today is producing about 50 tons of fine metal monthly, and within the next few years this tonnage will probably be doubled.

Chicote-Kami District — This district is situated on the Ayopaya River, along the La Paz-Cochabamba departmental boundary some 116 kilometers (72 miles) northeast of Oruro. The tungsten veins are found in the Chicote, Chicote Chico, and Kami mountains, of highly metamorphosed sandy shales, the beds standing almost upon end.

The vein system is a highly compli-

Chojlla tungsten mill with the camp site beyond it. The snow capped peak is Muruata. Orchids can be gathered near the plant

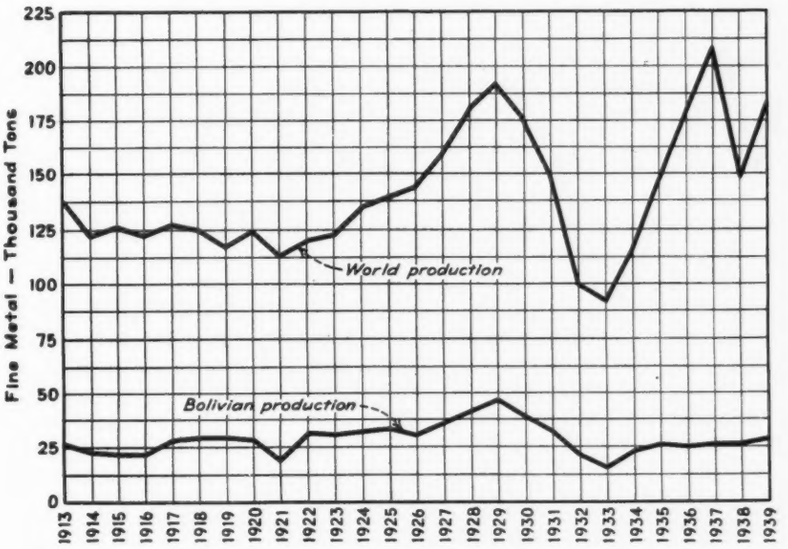

Fig. 1 . . . Annual production of tin, in metric tons of fine metal, for the world and for Bolivia, 1913 to 1939 inclusive

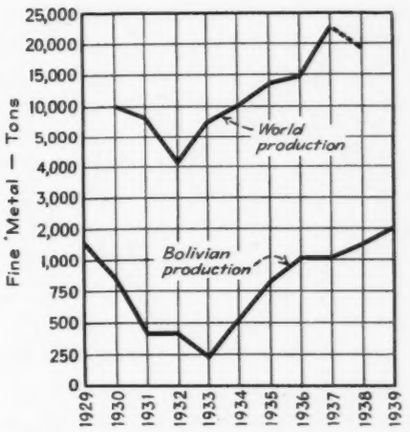

Fig. 2 . . . Annual production of tungsten, in metric tons of fine metal, for world and for Bolivia, 1930 to 1939 inclusive (world output for 1939 not available)

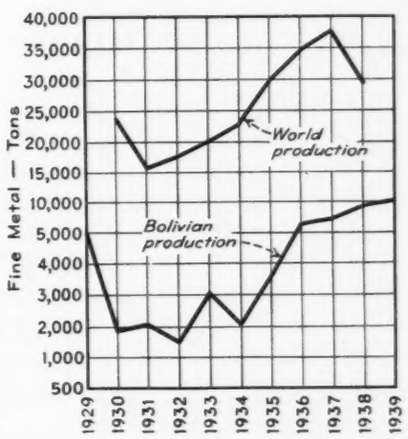

Fig. 3 . . . Antimony production annually for world and Bolivia respectively, in metric tons of fine metal, 1930 to 1939 inclusive (world output for 1939 not available)

cated network of small veinlets from a few centimeters to 40 cm. (16 in.) in width. The veins carry quartz, pyrite, arsenopyrite, and wolframite. They have no formal strike or dip, dipping from vertical to horizontal and striking in all directions. The mountain rises abruptly, and great masses have broken off along the bedding planes to form immense talus slopes at the foot of the peaks. This has provided steep cliffs, which expose the veins, although making it difficult to travel over and to prospect the exposures. Development has consisted, on Chicote Mountain, of drifting on the most promising vein exposures and then mining what wolframite was developed. In many places mining starts from the surface and all exposed wolframite is taken out. When the amount of barren rock increases greatly, the working is abandoned and work started on another exposure.

Talus Slide Provides Ore

On the north side of the Chicote Mountain is a large talus slide that was formed by the breaking off of a large section of the mountain. As this mass settled, the rock was thoroughly crushed. Today it appears as an immense slide of crushed rock, colored slightly yellow from the oxidation of the pyrite. Several operators are working in this talus slide, screening out the finely crushed material and discarding the coarse material. The fines go to small hand jigs and buddles, producing a tungsten concentrate assaying better than 60 per cent WO_3. It has been estimated that this talus slide contained some fifteen to thirty million tons of material. In 1938 one of the producers recovered 0.21 per cent WO_3 per ton of ore treated, treating only the fine material and discarding the coarse material, which those operating the property could not break. In excess of 100 tons fine WO_3 was produced from this talus deposit in 1938, using hand methods.

At Kami the veins are being developed, the average ore to mill assaying about 1½ per cent WO_3. This deposit is equipped with a mill and a small hydro-electric plant.

The Chicote-Kami district today is producing about 30 metric tons fine WO_3 monthly. With additional plants, for which additional ore reserves could be quickly blocked out, this production could be easily increased to 100 metric tons fine WO_3 monthly.

Esmoraca District—Esmoraca is situated in the southern part of the republic, and because of its rather isolated location is not well known. Formerly the district produced gold and bismuth. In 1932 tungsten was recognized, and since that date it has been the principal metal produced.

The country rock is andesite, which forms an immense flow, the bottom of the flow being about 4,000 meters (13,100 ft.) above sea level, measured at the northern end of the mountain range. The tops of the mountain range, which reach about 5,500 meters (18,000 ft.) above sea level, are of this same flow. Mining has been confined to small narrow veins of from 10 cm. to 30 cm. (4 to 12 in.) wide, assaying about 1 to 10 per cent WO_3. Occasionally pockets of high-grade tungsten ore are found which will assay 60 to 70 per cent WO_3 and contain several tons of metal. Such a pocket was cut in March, 1940, and, to date, 10 tons of fine metal has been removed. Because of the altitude, most of the mining has been confined to the lower section of the flow. Little prospecting has been done within the area of the flow. As usual with these small mines, operated on a shoestring, the ore is mined as fast as it is developed.

Production is usually small, amounting to about 1½ tons of fine metal monthly, except when the high-grade pockets are encountered. The concentrate, which assays about 70 per cent WO_3, is roasted to remove the arsenic before shipping. The shipped concentrates also carry about 40 grams of gold per ton.

Antimony Found in Shales

Antimony—In value antimony was the fourth principal mineral export from Bolivia during 1938 and 1939. Production first started in 1903, when 69 tons of fine metal were exported. In 1916 a peak of 27,413 tons of fine metal were exported, approximately a third of the world's production for that year. In 1938 Bolivia's production again reached 31.9 per cent of the world's production. After the first World War, production almost stopped, and then had a gradual revival, reaching a peak in 1927 with 6,717 tons of

fine metal exported. In 1936 production again began to climb, and since that date it has steadily increased. The year 1939 showed 10,053 tons of fine metal exported, being the peak since 1917, when 23,381 metric tons were shipped.

Antimony is produced entirely by hand methods, the ore being hand-mined, hand-sorted, crushed in rough home-made crushers, and washed in hand jigs or buddles. Production for any one property is sporadic. When a large pocket of stibnite is found, production increases rapidly. When the pocket has been exhausted, production will be confined to that produced from small stringers, development work, or from cleaning up dump material which was discarded when the mine was in bonanza.

The antimony deposits are found in the shales, extending along the eastern slopes of the Andes, from near Lake Titicaca southward into the Argentina. The most prolific deposits are in the Oruro and Potosi departments, these accounting for about 98 per cent of the Bolivian production. Three types of deposits are known—the straight antimony type, the antimony-gold type, and the antimony-tungsten type. Only the first two types of deposits will be described.

The larger districts of the straight antimony type are characterized by bleaching of the shales, small irregular quartz veinlets, which might be described as gash veinlets, and generally some antimony oxides staining the quartz. It is unusual for the antimony oxides to form large orebodies. The shale host rock is rapidly eroded because of the steep topography. Stibnite is the main mineral and sometimes it contains a small percentage of lead. The bulk of the production comes from pockets that sometimes contain several thousand tons of almost pure stibnite. The occurrence of Bolivia's antimony deposits is similar to that of the deposits which have been identified in Querétaro, Mexico.

Mining usually starts on small stringers. When an important pocket is discovered, tunnels or shafts may be driven to facilitate mining. Otherwise gouging is the principal mining system used.

Prospecting Recommended

The main districts are: La India, near Uncia; Agua Castilla, near Potosi; San Martin, near Yura; Cobija, near Oro Ingenio; and Santiago, near Oploca. Probably more than half of Bolivia's production comes from these large districts, where only the easily found surface material has been worked. Intelligent prospecting in these districts could probably more than double the production. In addition to these large areas, there are many small properties which produce only a few tons of stibnite monthly. They are worked by the small mine owners only during the most favorable market conditions.

The antimony-gold deposits are the most interesting. They must be classified as antimony deposits inasmuch as antimony and not gold is the metal of primary importance. The surface generally shows the bleached shales containing the small quartz or barite veinlets, which sometimes carry free gold. The orebodies are found as pockets with the principal gold values near the periphery. The gold is fine or coarse, free, and usually the material treated yields only a few grams per ton, although some small pockets of rich gold ore have been found. The gold production from this type of orebody is small. These ores are usually shipped to Europe, where the antimony smelters pay for approximately 95 per cent of the gold values if they exceed 20 grams per ton. The three principal antimony-gold deposits are: Chilleani, near Oruro; Taconi, near Colquechaca; and Sucre, near Esmoraca.

Table I—Résumé of Bolivian Exports, 1937–1939

Minerals	1937 Tons Fine Metal	1937 Value in £	1937 %	1938 Tons Fine Metal	1938 Value in £	1938 %	1939 (a) Tons Fine Metal	1939 (a) Value in £	1939 (a) %
Tin	25.530.9	6.141.424	67.65	25.893.4	4.851.910	68.22	27.648.0	6.264.898	72.18
Silver	293.8	790.927	8.71	198.2	517.247	7.27	225.2	613.797	7.07
Tungsten	1.081.3	327.282	3.60	1.517.7	388.158	5.46	2.001.6	467.104	5.36
Antimony	7.126.9	265.510	2.92	9.436.8	239.915	3.37	10.053.3	343.948	3.97
Lead	18.288.6	425.350	4.68	13.168.5	201.163	2.83	14.125.4	215.643	2.49
Copper	3.692.8	205.767	2.27	2.885.1	116.622	1.64	3.956.5	178.693	2.06
Zinc	11.529.0	266.561	2.94	10.706.6	150.921	2.12	7.768.5	114.824	1.33
Gold	0.1	30.072	0.33	0.3	73.092	1.03	0.3	65.216	0.75
Sulphur	.....	8.179	0.09	.....	9.646	0.13	.....	11.642	0.14
Bismuth	30.8	13.606	0.15	17.2	7.621	0.11	12.7	5.483	0.06
Others	.....	.....	.....	.....	.....	.....	248.4	4.243	0.05
Total minerals	67.574.2	8.474.678	93.34	63.823.8	6.556.295	92.18	66.039.9	8.285.491	95.46
Non-minerals	.....	604.030	6.66	.....	555.929	7.82	.....	393.997	4.54
Total exports	.....	9.078.708	100.00	.....	7.112.224	100.00	.....	8.679.488	100.00

(a) Preliminary figures.
1939 Annual Report Banco Central de Bolivia.

Table II—Percentage of World Output of Strategic Minerals Produced in World Market

	1937 %	1938 %	1939(a) %
Tin	12.2	17.5	15.0
Tungsten	4.0	7.9	(b)
Antimony	19.1	31.9	(b)

(a) Preliminary figures
(b) World figures not yet available.

Table III—Bolivian Tin Quota

	Bolivian Quota	Exports	% of Quota
1937..	49,397	25,531	31.6
1938..	27,562	25,893	93.8
1939..	35,504	27,648	77.9

Table IV—Mining Companies Producing Approximately 80 Per Cent of Country's Output of Tin

Company	Metric Tons Fine Tin Yearly Exports 1939	Plant Capacity	% of Bolivia's Capacity
Patiño Mines & Enterprises Cons. Inc.	7,691	18,000	37.50
Cia. Unificada del Cerro de Potosi	3,806	5,400	11.25
Cia. Minera de Oruro	2,678	4,800	10.00
Cia. Aramayo Minas de Bolivia	1,911	4,200	8.75
Bolivian Tin & Tungsten Mines Corp.	2,890	3,600	7.50
Cia. Minera y Agricola Oploca de Bolivia	1,312	1,800	3.75
Sociedad Empresa de Estano Araca	686	1,200	2.50
Sub-total	20,974	39,000	81.25
Small producers	6,674	9,009	18.75
Total	27,648	48,000	100.00

Lead-Silver Mines

The lead-silver mines of Bolivia could also form an important source of antimony. Of these, the Huanchaca and Oruro companies ship concentrates which carry from 6 to 10 per cent antimony. As important tonnages of these concentrates are produced, the antimony content is considerable. Many other small properties, now idle, could produce similar type of concentrates. As the smelters do not pay for this antimony, it is not included in the production figures for Bolivia presented herewith.

Acknowledgment is made to the executives of the various mining companies who have kindly permitted this information to be published.

NEW BOOKS

CHAMBERS TECHNICAL DICTIONARY. *By C. F. Tweney and L. C. Hughes, Editors. The Macmillan Company, 60 Fifth Ave., New York. Pp. 957. Price $5.*

AS STATED by the publisher, this dictionary comprises terms used in pure and applied science, medicine, the chief manufacturing industries, engineering, construction, and the mechanics trades. It would seem as if such a volume, containing as it does many thousands of definitions, should be of much value for reference purposes. To make a fair appraisal of its worth would be difficult. This appraisal should consider at least the completeness of the list in each of the branches of technology mentioned and the accuracy of the individual definition. Considering only mining technology and looking up some familiar terms as they occur to mind, the result, we find, is not so good. "Stope" for instance is defined as "the space left after the excavation of ore from a tabular deposit." For "mucking" one is told to see "lashing." The latter is correctly defined as a South African term for removing broken rock after blasting, but, it is added that the Canadian term is "mucking." Let us say that "mucking" is also the American term. Moreover, the terms "scraping" and "slushing" do not appear. The lexicographer here is clearly English, as this instance and others such as the subordination of "hoisting" to "winding" indicates. This is something that the American user ought to know. A dredge man would never recognize the definition of "gantry," which is limited to the building field and defined simply as a "temporary erection having a working platform, etc." Possibly this quick test is unfairly inadequate and the lexicographer's percentage of accuracy is high. It serves, however, to point the fact that the making of a dictionary is a colossal undertaking and that anyone engaged to define the terms in a particular field should be thoroughly familiar with their usage, especially in such a world-wide field as mining.

COMBUSTION Y COMBUSTIBLES. *By Prof. Pablo Krassa. Published in Spanish by Empresa Editora Zig Zag S.A., Box 84-D., Santiago de Chile, Chile. Pp. 508. Price, not given.*

THE AUTHOR of this book on combustion and fuels, who is on the faculty of the University of Chile, states that it is based on his lecture notes used in his classes in industrial chemistry in the School of Engineering. In his introduction he discusses world and Chilean sources of power, world trade in fuels, and power production and consumption in Chile. Part I deals with fuels occurring in nature, Part II with properties and utilization of natural and manufactured fuels; also with combustion and equipment used in burning fuels; and with the conversion of fuels, one into another, as in hydrogenation and the synthesis of hydrocarbons. Part III deals with lubrication and lubricants, Part IV with mechanical cleaning of fuels, Part V with action of fuel in storage and means for keeping it in good condition. Part VI, the last, with briquetting of coal fines. The book has 180 illustrations.

INTRODUCTION TO ELECTRICAL MACHINES. *By A. W. Hirst, chief lecturer on electrical engineering, College of Engineering, Leicester, England. Distributed by Chemical Publishing Company, Inc., 148 Lafayette St., New York. Pp. 122. Price $2.25.*

THIS VOLUME is one of a series intended to provide a number of comparatively small low-priced books, each dealing with a section of electrical engineering. Intelligent use of it calls for a knowledge of elementary physics and mathematics up to and including calculus. It contains five chapters on the following respective topics: Electromagnetism and electromagnetic induction; the magnetic circuit and magnetic calculations; the electromagnetic machine; insulation and insulating materials; losses—heating and ventilating of machines; wave forms and harmonic analysis.

MINERAL IDENTIFICATION SIMPLIFIED. *By Orsino C. Smith. Published by Wetzel Publishing Company, Los Angeles, Calif. 5x7¼ in. Pp. 271. Price $5.30.*

ENDEAVORING to include all important minerals mentioned in literature up to Jan. 1, 1940, the author offers a method for simple mineral identification by a series of tables listing over 2,000 minerals. It is based on two of a mineral's most constant physical characteristics, specific gravity and hardness, and by the determination of those two simple properties the great majority of minerals are eliminated and the specimen is placed as one of a few minerals in a certain group. There are six chapters, respectively headed as follows. The Table; Testing for the Chemical Constituents; Qualitative Tests; Special Tests; Blowpipe Tables; and Abbreviations. All chapters are short but still complete and furnish the base upon which the reader can refer the results of his tests to the large group of tables for identification. The tables are simple to follow and the more common and important minerals are in boldface type. In addition to a general index, this handy pocket size reference book contains a mineral index. Mineralogists, geologists, and persons having mineral study as a hobby will find this volume worth while.

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PUBLICATIONS

RECEIVED

Hungarian Statistical Annual, 1938. Edited and published by Central Royal Hungarian Office of Statistics, Budapest. In French. Pp. 444. Price 6 pengös.

Simple Blueprint Reading, With Special Reference to Welding. The Lincoln Electric Co., Cleveland, Ohio. Pp. 138. Price 50c. in United States, postage prepaid; elsewhere 75c.

Dominion Bureau of Statistics, Ottawa, has issued the following at the prices stated: Finally Revised Statistics on Mineral Production of Canada, 1939, pp. 9, price 25c. Also, Summary Review of Silver Mining Industry in Canada, 1939, pp. 25, price 25c.

Mines and Geology Branch, Department of Mines and Resources, Ottawa, has issued the following Geological Survey Papers, at the respective prices stated: Paper 40-1, Preliminary Map, Jumpingpound, Alberta, by G. S. Hume, price 10c. Also Paper 40-6, Preliminary Map, Bragg Creek, Alberta, by G. S. Hume and H. H. Beach, price 10c. Also Paper 40-10, Stony Rapids and Porcupine River Areas, Saskatchewan, by G. M. Furnival, price 10c. Also Paper 40-12, Zeballos Mining District and Vicinity, British Columbia, by M. F. Bancroft, price 10c. Also Paper 40-14, Quyta Lake and Parts of Fishing Lake and Prosperous Lake Areas, Northwest Territories, by A. W. Jolliffe, price 10c. Also the following:

Memoir 223, Mineral Resources, Hazelton and Smithers Areas, Cassiar and Coast Districts, British Columbia, pp. 107, price 25c. Also Paper 40-2, Wildcat Hills Map-Area, East Half, Alberta, pp. 9, plus map, price 10c. Also Preliminary Maps, at 10c. each, of Michwacho Lake, Abitibi Territory, Quebec; Mechamego Lake, Abitibi Territory, Quebec; Fish Creek, Alberta; Gordon Lake South, Northwest Territories; and Gordon Lake, Northwest Territories.

Practical Design of Small Motors and Transformers. By E. Molloy. Published by Chemical Publishing Co., Inc., New York. Page 176. Price $2.

Business Law of Colombia. By James Wallace Raisbeck, Jr. Published by the Jarrett Printing Co., Charleston, W. Va. Printed in English. Maroon cloth binding; 9¼x6½ in. Pp. 450. Price $10 postpaid. Complete and detailed information of the mining laws of Colombia; labor and tax legislation and practice; interpretation of judicial edicts; licenses; civil code, and related matters; comprising, in all, eighteen chapters. Appendices cover reciprocal trade agreements between the United States and Colombia and rules regulating exports to Colombia from the United States.

Bulletin for editors of employee publications. Published by American Association of Industrial Editors, 1964 E. Ninth St., Cleveland, Ohio. June issue contains addresses delivered at annual convention.

Federated Malay States. Annual Report on Administration of Mines Department and on the Mining Industries, 1939. By A. E. Kershaw. Published at Kuala Lumpur, F. M. S., pp. 42. Price $1, Straits, or 2s, 4d.

Kenya Colony. Annual Report (1939) of Mining and Geological Department. Box 339, Nairobi, Kenya Colony. Pp. 15.

Timber Research Laboratory. Report of consultant for Transvaal Chamber of Mines, Johannesburg, South Africa. Pp. 23.

Summary of the

MARKETS

WITH general industrial activity expanding, largely because of armament orders, consumers were eager to contract for raw materials well into 1941. Purchases of major non-ferrous metals were unusually heavy until late in September, when a warning from Washington aimed at checking an upward movement in prices caused buyers to take a more reasonable view of the situation. A member of the Defense Commission made it clear that price controls would be invoked in the event that orderly markets could not be maintained.

The E.&M.J. price index for September advanced 2.69 points to 79.40, close to the high for the current year established last January. Monthly averages were higher in domestic copper, lead, and zinc. Tin was lower.

Two buying waves struck the domestic market for copper during September, an unusual condition, and the quotation scored a net gain of 1c. Business booked for the month totaled 254,976 tons, the largest single month's sales on record. Visible stocks of copper were in firm hands, creating a tight situation marketwise. Orders for fabricated materials for British account and substantial buying for defense here inspired much of the business. Another factor was the feeling that the war would be of long duration. At 12c., Valley, domestic copper is one-half cent below the peak for 1940. Japan was in the market for substantial tonnages of foreign copper, which, added to some British orders, kept the export quotation on a fairly even keel. Great Britain is expected to use more foreign metal on orders for fabricated products placed in the United States, taking advantage of duty drawback privileges.

Undelivered contracts in the common grades of zinc amounted to more than 90,000 tons toward the end of September. Forward buying in zinc occurred in the face of rising prices. Buyers feared that supplies would run short. Producers, however, look for relief in the matter of supplies before the end of the year.

The advance in lead was checked by the threat of larger imports for domestic consumption. Tin prices firmed up late in the month, because of the political situation in the Far East.

UNITED STATES MARKET

1940	Electrolytic Copper		Straits Tin	Lead		Zinc
Sept.	Domestic (a) Refinery	Export (b) Refinery	New York	New York	St. Louis	St. Louis
2	Holiday	9.850	Holiday	Holiday	Holiday	Holiday
3	10.775	9.850	50.500	4.90	4.75	6.50
4	10.775	9.875	50.500	4.90	4.75	6.50
5	10.775 @ 11.275	9.850	50.375	4.90	4.75	6.50 @ 6.85
6	11.275	9.850	50.250	4.90	4.75	6.85
7	11.275	9.850	50.250	4.90	4.75	6.85
9	11.150 @ 11.275	9.850	50.250	4.90	4.75	6.85
10	11.150	9.850	50.125	4.90	4.75	6.85
11	11.025	9.850	50.100	4.90	4.75	6.85
12	11.025	9.850	50.050	4.90	4.75	6.85
13	11.150	9.850	50.050	4.90	4.75	6.85
14	11.150	9.850	50.050	4.90	4.75	6.85
16	11.150	9.800	50.050	4.90	4.75	6.85
17	11.150	9.850	50.050	4.90	4.75	6.85
18	11.150 @ 11.275	9.850	50.050	4.90	4.75	6.85
19	11.275	9.850	50.050	4.90	4.75	6.85
20	11.275	9.850	50.050	4.90	4.75	6.85
21	11.275	9.850	50.050	4.90	4.75	6.85
23	11.275	9.850	50.075	5.00	4.85	7.00
24	11.775	9.850	50.100	5.00	4.85	7.25
25	11.775	9.850	50.375	5.00	4.85	7.25
26	11.775	9.850	50.500	5.00	4.85	7.25
27	11.775	9.850	51.500	5.00	4.85	7.25
28	11.775	9.850	51.500	5.00	4.85	7.25
30	11.775	9.850	51.500	5.00	4.85	7.25
			AVERAGES FOR MONTH			
Sept.	11.296	9.849	50.348	4.929	4.779	6.920
			AVERAGES FOR WEEK			
Sept.						
4	10.775	9.854	50.500	4.900	4.750	6.500
11	11.160	9.850	50.225	4.900	4.750	6.821
18	11.140	9.842	50.050	4.900	4.750	6.850
25	11.442	9.850	50.117	4.950	4.800	7.008
			CALENDAR WEEK AVERAGES			
Sept.						
7	11.025	9.854	50.375	4.900	4.750	6.675
14	11.119	9.850	50.104	4.900	4.750	6.850
21	11.223	9.842	50.050	4.900	4.750	6.850
28	11.692	9.850	50.675	5.000	4.850	7.208

SILVER, GOLD AND STERLING EXCHANGE

1940	Sterling Exchange		Silver		Gold	
Sept.	"Checks"	"90-day demand"	(c) New York	London	London	(d) United States
2	Holiday	(f)	Holiday	23.4375	168s	Holiday
3	402.000	(f)	34.750	23.5000	168s	$35.00
4	401.500	(f)	34.750	23.4375	168s	35.00
5	401.500	(f)	34.750	23 4375	168s	35.00
6	403.000	(f)	34.750	23.4375	168s	35.00
7	403.000	(f)	(e)	(e)	(e)	35.00
9	402.000	(f)	34.750	23.4375	168s	35.00
10	401.000	(f)	34.750	23.5000	168s	35.00
11	401.000	(f)	34.750	23.4375	168s	35.00
12	401.000	(f)	34.750	23.4375	168s	35.00
13	402.000	(f)	34.750	23.4375	168s	35.00
14	401.000	(f)	(e)	(e)	(e)	35.00
16	401.500	(f)	34.750	23.3750	168s	35.00
17	402.000	(f)	34.750	23.5000	168s	35.00
18	402.000	(f)	34.750	23.4375	168s	35.00
19	401.000	(f)	34.750	23.4375	168s	35.00
20	402.000	(f)	34.750	23.4375	168s	35.00
21	401.000	(f)	(e)	(e)	(e)	35.00
23	401.000	(f)	34.750	23.5000	168s	35.00
24	401.000	(f)	34.750	23.4375	168s	35.00
25	402.000	(f)	34.750	23.4375	168s	35.00
26	403.000	(f)	34.750	23.4375	168s	35.00
27	401.000	(f)	34.750	23.4375	168s	35.00
28	402.000	(f)	(e)	(e)	(e)	35.00
30	401.000	(f)	34.750	23.4375	168s	35.00
			AVERAGES FOR MONTH			
Sept.	401.646	.....	34.750	23.446	.....	35.00
			AVERAGES FOR WEEK			
Sept.						
4	401.600	.....	34.750	.....	....	....
11	401.917	.....	34.750	.....	....	.....
18	401.583	.....	34.750	.....	....	.....
25	401.333	.....	34.750	.....	....	.....

Calendar week averages, New York Silver: Sept. 7th, 34.750; 14th, 34.750; 21st, 34.750; 28th, 34.750.

(e) Not quoted (Saturday). (f) No quotation.

THE above quotations for major non-ferrous metals are our appraisal of the important United States markets, based on sales reported by producers and agencies. They are reduced to the basis of cash, New York or St. Louis, as noted. All prices are in cents per pound.

(a) Net prices at refineries on Atlantic seaboard. To arrive at the delivered New England basis add 0.225c. per pound, the average differential for freight and delivery charges.

(b) Export prices are net at refineries on the Atlantic seaboard and include sales of domestic copper in the foreign market. Owing to the European War and the disruption of normal trade relations, our export copper quotations, since September, 1939, have been based largely on f.a.s. transactions, ex United States ports. To arrive at the f.o.b. refinery quotation deduct .05 from the f.a.s. basis for lighterage.

Copper, lead and zinc quotations are based on sales for both prompt and future deliveries; tin quotations are for prompt delivery only.

Quotations for copper are for the ordinary forms of wirebars and ingot bars; cathodes are sold at a discount of 0.125c.

Quotations for zinc are for ordinary Prime Western brands. Zinc in New York commands a premium over the St. Louis basis equal to the freight differential. Contract prices for High Grade zinc delivered in the East and Middle West in nearly all instances command a premium of 1c per pound over the current market for Prime Western but not less than 1c over the *Engineering and Mining Journal's* average quotation for Prime Western for the previous month.

Quotations for lead reflect prices obtained for common lead, and do not include grades on which a premium is asked.

(c) Silver other than newly-mined domestic, by Handy & Harman. Under Treasury order of July 6, 1939, the price on domestic newly-mined silver mined subsequent to July 1, 1939, was fixed at 71.11c per troy ounce. Handy & Harman's quotation on newly-mined domestic silver, 999 fine was 70⅝c throughout September.

(d) U. S. Treasury's gold price. Actual payment by the United States Treasury for gold in domestic and imported ore or concentrate is at 99.75 per cent of the price quoted by the Treasury, which at present is equal to $34.9125.

PRICES OF METALS • MISCELLANEOUS QUOTATIONS

LONDON MARKET

1940 Sept.	Copper Standard Spot	Copper Standard 3 months	Copper Electro Bid	Tin Standard Spot	Tin Standard 3 months	Lead Spot Buyers	Lead Spot Sellers	Lead 3 months Buyers	Lead 3 months Sellers	Zinc Spot Buyers	Zinc Spot Sellers	Zinc 3 months Buyers	Zinc 3 months Sellers
2	Not quoted			257.2500	258.2500	Not quoted							
3	"	"		255.5000	256.7500	"	"						
4	"	"		254.7500	256.5000	"	"						
5	"	"		255.2500	256.7500	"	"						
6	"	"		256.0000	257.0000	"	"						
9	"	"		250.0000	253.0000	"	"						
10	"	"		249.0000	251.5000	"	"						
11	"	"		248.0000	251.0000	"	"						
12	"	"		243.5000	246.5000	"	"						
13	"	"		243.0000	246.5000	"	"						
16	"	"		239.0000	243.5000	"	"						
17	"	"		243.0000	246.7500	"	"						
18	"	"		245.0000	249.0000	"	"						
19	"	"		247.0000	251.2500	"	"						
20	"	"		247.5000	251.7500	"	"						
23	"	"		254.0000	258.0000	"	"						
24	"	"		254.2500	258.0000	"	"						
25	"	"		255.5000	259.0000	"	"						
26	"	"		257.0000	260.0000	"	"						
27	"	"		259.5000	262.5000	"	"						
30	"	"		257.5000	261.0000	"	"						
Average for month				251.024									

Prices for tin are the official prices of the London Metal Exchange, in long tons (2240 lb.). Trading in other metals remained suspended.

CURRENT PRICES — MISCELLANEOUS METALS, ORES, AND NON-METALLIC MINERALS

Quotations cover wholesale lots, prompt shipment, f.o.b. New York, unless otherwise stated

(Oct. 1, 1940)

MISCELLANEOUS METALS

Aluminum, ingot, 99 plus per cent, lb	18c.
Antimony, domestic, spot, lb	14.00c.
Bismuth, ton lots, lb	$1.25
Cadmium, commercial sticks, lb	80c.
Calcium, lb., ton lots 97 @ 98 per cent	Nominal
Chromium, 97 per cent grade, lb	89c.
Cobalt, 97 to 99 per cent, per lb	$1.50
Nickel, electrolytic cathodes, lb	35c.
Magnesium, 99.8 per cent, carloads, lb	27c.
Palladium, troy oz	$24.00
Platinum, (Official quotation) troy oz	$36.00
Quicksilver, flask of 76 lb., 100 flasks or more	$173.00
Radium, mg. radium content	$25.00@$30.00
Selenium, 99.5 per cent, lb	$1.75
Silicon, minimum 97 per cent, spot, lb	16.50c.
Tellurium, lb	$1.75
Thallium, 100 lb. or more, lb	$6.50
Titanium, 96 to 98 per cent, lb	$5.00

METALLIC ORES

Beryllium Ore, f.o.b. mines, ton	$30.00@$36.00
Chrome Ore, 48 @ 50% Cr_2O_3 c.i.f. Atl. ports, long ton	(b)$34.00@$36.00
Iron Ore, Lake Superior, Lower Lake ports, long ton:	
Old Range bessemer	$4.75
Mesabi bessemer	$4.60
Old Range non-bessemer	$4.60
Mesabi, non-bessemer	$4.45
Lead (Galena) 80 per cent, Joplin, Mo., ton	$57.34
Manganese Ore, (foreign) c.i.f. U.S. ports, long ton unit of Mn:	
52 @ 55 per cent	(b) 58c.
50 @ 52 per cent	(b) 58c.
46 @ 48 per cent	(b) 50@52c.
Molybdenum Ore, 90%, per lb. of MoS_2, f.o.b. mines	45c.
Tungsten Ore, per unit of WO_3:	
Chinese, 65 per cent, duty paid	$24.50
Domestic, 65 per cent and upward	(a)$22.00@$23.00
Vanadium Ore, per lb. of contained V_2O_5	27½c.
Zinc Ore, Prime, 60 per cent concentrate, Joplin, Mo.; per ton	$48.00

(a) Prices at mines, small lots, usually several dollars less. (b) Nominal.

METALLIC COMPOUNDS

Arsenious Oxide (arsenic) lb	3¼c.
Cobalt Oxide, 70 @ 71 per cent, lb	$1.84
Copper Sulphate, 100 lb	$4.75
Sodium Nitrate, ex vessel, in 200-lb. bags, per 100 lb	$1.42
Sodium Sulphate, bulk ton	$17.00@$18.00

ALLOYS

Beryllium Copper, master alloy, 2.5 to 3 per cent Be, per lb. of contained Be	$15.00
Ferrochrome, 65 @ 70 per cent chromium, 4 @ 6 per cent carbon, lb	11c.
Ferromanganese, 78 @ 82 per cent, gross ton	$120.00
Ferromolybdenum, 55 @ 65 per cent Mo. lb. of Mo. contained	95c.
Ferrosilicon, 50 per cent, gross ton	$74.50
Ferrotungsten, 75 @ 80 per cent, lb. of W contained	$1.90@$2.00

NON-METALLIC MINERALS

Asbestos, f.o.b. mines (U.S. funds), ton:	
Canadian (Quebec)	
Crude No. 1	$700@$750
Crude No. 2	$150@$350
Spinning fibers	$110@$200
Paper stock	$40@$45
Shorts	$13@$17.50
Vermont	
Shingle stock	$57
Paper stock	$40
Cement stock	$25
Barytes, long ton:	
Georgia, crude	$7.00
Missouri, 93 per cent $BaSO_4$, less than 1 per cent iron	$6.00@$6.50
Bauxite, long ton:	
Domestic, chemical, 55 @ 58 per cent	$7.00@$8.00
Domestic, abrasive, 80 @ 84 per cent	$14.00
Dalmatian, 50 @ 55 per cent	Nominal
French, 56 @ 59 per cent	Nominal
China Clay, f.o.b. mines, ton:	
South Carolina and Georgia, No. 1, bulk	$6.75@$8.00
Delaware, No. 1	$14.50
Feldspar, bulk, ton:	
Potash feldspar, 200 mesh	$17.00
Glass-spar, white, 20 mesh	$11.75
Fluorspar, f.o.b. mines, bulk, Kentucky and Illinois 85–5 per cent, all rail movement, ton	$21.00
Fuller's earth, f.o.b. Georgia or Florida, ton	$7.00@$14.00
Magnesite, per ton:	
Dead-burned, f.o.b. California	$25.00
Dead-burned, f.o.b. Washington	$22.00
Mica, per lb., North Carolina, No. 1 and 2 quality:	
1½ x 2 in.	45@60c.
2 x 2 in.	60@80c.
3 x 3 in.	$1.25@$1.50
3 x 4 in.	$1.50@$1.75
3 x 5 in.	$1.75@$2.25
White, ground, 70 mesh, ton	$60.00@$80.00
Ocher, Georgia, ton	$19.00@$22.00
Pyrites, Spanish, per long ton unit of S, c.i.f. Atlantic ports	(a) 12c.
Silica, in bags, 325 mesh, ton	$20.00@$40.00
Sulphur, Texas, mines, long ton	$16.00
Talc, f.o.b. works, ton:	
New York, double air-floated, 325 mesh	$12.00@$15.00
New Jersey, mineral pulp	$8.50@$10.50
Vermont, extra white, 200 mesh	$9.50@$10.00
Tripoli, Missouri, ton:	
40 mesh, cream colored	$14.50
200 mesh, cream colored	$26.00

(a) Nominal

IRON AND STEEL

Pig Iron, Valley furnaces, gross ton:	
Bessemer	$23.50
Basic	$22.50
No. 2 Foundry	$23.00
Steel, base prices, Pittsburgh:	
Billets, gross ton	$34.00
Structural shapes, 100 lb	$2.10
Bars, 100 lb	$2.15

Monthly and Yearly

AVERAGE PRICES

SILVER AND STERLING EXCHANGE

	New York		London Spot		Sterling Exchange	
	1939	1940	1939	1940	1939	1940
January	42.750	34.750	20.305	21.892	466.775	395.442
February	42.750	34.750	20.370	20.935	468.472	395.652
March	42.750	34.750	20.280	20.763	468.370	375.212
April	42.750	34.750	20.031	20.713	467,778	351.817
May	42.750	34.949	20.123	21.878	467.988	326.452
June	41.955	34.825	19.505	22.688	468.137	359.560
July	34.944	34.750	16.952	22.095	468.031	379.750
August	35.951	34.750	17.719	23.261	460.383	396.889
September	36.956	34.750	22.178	23.446	398.820	401.646
October	35.726	.....	22.736	.....	400.350	.....
November	34.750	.....	23.378	.....	391.457	.....
December	34.956	.....	23.263	.....	391.830	.....
Year	39.082	.....	20.570	.....	443.199	.....

New York quotations for silver other than newly-mined domestic, cents per ounce troy, 999 fine, London pence per ounce sterling silver 925 fine. Sterling exchange (pound sterling) in cents.

COPPER

	F.O.B. Refinery, Electrolytic				London Spot			
	Domestic		Export		Standard		Electrolytic (a)	
	1939	1940	1939	1940	1939	1940	1939	1940
January	11.025	11.954	9.912	11.999	43.125	(b)	48.440	(b)
February	11.025	11.148	9.735	11.471	42.188	(b)	47.375	(b)
March	11.025	11.160	9.888	11.407	42.938	(b)	48.120	(b)
April	10.265	11.087	9.820	11.258	42.031	(b)	47.833	(b)
May	9.833	11.079	9.738	11.191	41.656	(b)	47.528	(b)
June	9.775	11.128	9.738	11.216	41.986	(b)	47.528	(b)
July	9.976	10.564	9.944	10.189	42.899	(b)	48.863	(b)
August	10.261	10.708	10.211	9.851	44.685	(b)	50.409	(b)
September	11.635	11.296	11.685	9.849	(b)	(b)	(b)	(b)
October	12.215	.....	12.491	.....	(b)	.....	(b)	.....
November	12.275	.....	12.929	.....	(b)	.....	(b)	.....
December	12.275	.....	12.631	.....	(b)	.....	(b)	.....
Year	10.965	.....	10.727	.....	(c)42.689	.....	(c)48.262	.....

New York quotations, cents per pound. London, pounds sterling per long ton, (a) Bid quotations. (b) No quotations. (c) Average for eight months.

LEAD

	New York		St. Louis		London			
	1939	1940	1939	1940	1939 Spot	1939 3 mos.	1940 Spot	1940 3 mos.
January	4.826	5.471	4.676	5.321	14.534	14.744	(a)	(a)
February	4.805	5.076	4.655	4.926	14.283	14.417	(a)	(a)
March	4.824	5.192	4.674	5.042	14.660	14.860	(a)	(a)
April	4.782	5.071	4.632	4.921	14.337	14.533	(a)	(a)
May	4.750	5.015	4.600	4.865	14.483	14.679	(a)	(a)
June	4.800	5.000	4.650	4.850	14.564	14.651	(a)	(a)
July	4.854	5.000	4.704	4.850	14.753	14.856	(a)	(a)
August	5.043	4.854	4.893	4.704	16.040	15.885	(a)	(a)
September	5.449	4.929	5.299	4.779	(a)	(a)	(a)	(a)
October	5.500	.....	5.350	.....	(a)	(a)	.....	.....
November	5.500	.....	5.350	.....	(a)	(a)	.....	.....
December	5.500	.....	5.350	.....	(a)	(a)	.....	.....
Year	5.053	.....	4.903	.....	(b)14.707	(b)14.828	.....	.....

New York and St. Louis quotations, cents per pound. London pounds sterling per long ton. (a) No quotations. (b) Average for eight months.

TIN

	Straits New York		Standard, Spot London	
	1939	1940	1939	1940
January	46.404	46.707	215.435	240.716
February	45.640	45.851	213.906	242.833
March	46.213	47.079	215.375	251.711
April	47.160	46.815	218.389	252.080
May	49.031	51.570	225.591	264.098
June	48.853	54.618	227.511	273.438
July	48.548	51.591	229.833	265.592
August	48.793	51.176	229.869	262.455
September	64.588	50.348	229.292	251.024
October	55.580	.....	229.943	.....
November	52.322	.....	230.000	.....
December	50.740	.....	248.974	.....
Year	50.323	.....	226.177	.....

New York quotations, cents per pound. London, pounds sterling per long ton.

ZINC

	St. Louis		London			
	1939	1940	1939 Spot	1939 3 mos.	1940 Spot	1940 3 mos.
January	4.500	5.644	13.682	13.887	(a)	(a)
February	4.500	5.534	13.522	13.780	(a)	(a)
March	4.500	5.750	13.728	13.961	(a)	(a)
April	4.500	5.750	13.443	13.637	(a)	(a)
May	4.500	5.803	13.717	13.938	(a)	(a)
June	4.500	6.235	14.023	14.223	(a)	(a)
July	4.516	6.250	14.235	14.435	(a)	(a)
August	4.719	6.389	14.628	14.761	(a)	(a)
September	6.104	6.920	(a)	(a)	(a)	(a)
October	6.500	.....	(a)	(a)	.....	.....
November	6.500	.....	(a)	(a)	.....	.....
December	5.980	.....	(a)	(a)	.....	.....
Year	5.110	.....	(b)13.872	(b)14.078	.....	.....

St. Louis quotations, Prime Western, cents per pound. London, pound sterling per long ton. (a) No quotations. (b) Average for eight months.

CADMIUM AND ALUMINUM

	Cadmium		Aluminum	
	1939 (a)	1940 (a)	1939	1940
January	58.400	79.038	20.000	20.000
February	55.000	80.000	20.000	20.000
March	54.259	80.000	20.000	19.769
April	50.000	80.000	20.000	19.000
May	50.000	80.000	20.000	19.000
June	50.000	80.000	20.000	19.000
July	50.000	80.000	20.000	19.000
August	53.704	80.000	20.000	18.000
September	64.200	80.000	20.000	18.000
October	74.600	.....	20.000	.....
November	75.000	.....	20.000	.....
December	75.000	.....	20.000	.....
Year	59.180	.....	20.000	.....

Aluminum in cents per pound, 99 plus per cent grade. Cadmium, cents per pound. (a) Producers' price, commercial sticks.

ANTIMONY, QUICKSILVER, AND PLATINUM

	Antimony (a) New York		Quicksilver (b) New York		Platinum (c) New York	
	1939	1940	1939	1940	1939	1940
January	11.670	14.000	77.440	156.962	34.440	40.000
February	11.250	14.000	85.227	178.000	35.000	40.000
March	11.269	14.000	87.278	180.921	35.000	40.000
April	11.500	14.000	90.800	173.538	35.000	38.923
May	11.712	14.000	86.769	181.538	35.000	38.000
June	12.000	14.000	86.615	197.360	35.000	38.000
July	12.000	14.000	86.960	194.423	35.000	38.000
August	12.000	14.000	84.407	184.111	35.333	38.000
September	12.910	14.000	140.000	173.333	40.080	36.167
October	14.000	.....	145.600	.....	41.120	.....
November	14.000	.....	134.978	.....	40.000	.....
December	14.000	.....	141.200	.....	40.000	.....
Year	12.359	.....	103.940	.....	36.748	.....

(a) Antimony, cents per pound, ordinary brands, in cases; in bulk 13.415 for September. (b) Quicksilver, dollars per flask of 76 lb. (c) Platinum, dollars per ounce troy.

PIG IRON

	Bessemer		Basic		No. 2 Foundry	
	1939	1940	1939	1940	1939	19400
January	21.50	23.50	20.50	22.50	21.00	23.00
February	21.50	23.50	20.50	22.50	21.00	23.00
March	21.50	23.50	20.50	22.50	21.00	23.00
April	21.50	23.50	20.50	22.50	21.00	23.00
May	21.50	23.50	20.50	22.50	21.00	23.00
June	21.50	23.50	20.50	22.50	21.00	23.00
July	21.50	23.50	20.50	22.50	21.00	23.00
August	21.50	23.50	20.50	22.50	21.00	23.00
September	22.50	23.50	21.50	22.50	22.00	23.00
October	23.50	.....	22.50	.....	23.00	.....
November	23.50	.....	22.50	.....	23.00	.....
December	23.50	.....	22.50	.....	23.00	.....
Year	22.083	.....	21.083	.....	21.583	.....

Iron, dollars per long ton. F.o.b. Mahoning and Chenango Valley furnaces.

PERSONAL ITEMS

J. E. Wells has joined the staff of Balatoc Mining Company, Baguio, P. I.

Bernard D. Cullity has been appointed to the faculty of the Montana School of Mines as an instructor in metallurgy.

Scott Turner returned to New York late in August, and left at once for New Mexico.

F. E. Porter has resigned as president and manager of Tintic Ophir Mining Company, operating in Tooele County, Utah.

Harold Kingsmill, vice-president of Cerro de Pasco Copper Corporation, has been elected a director of the American Metal Company.

Edwin B. Michal has returned to Round Mountain, Nev., from Alma, Colo., where he was assistant superintendent of the South London flotation mill.

George W. Danehy has returned to his Reno office after extensive examination work conducted in Gilpin County, Colo., for Kingdon Gould, of New York.

Stuart Love, consulting engineer, has left Melbourne for Papua to supervise plant erection and organize the operations of Gordon's Misima, N. L., Misima Island, Papua.

Herman C. Bellinger, vice-president in charge of operation for the Chile Exploration Company, has been awarded the William Lawrence Saunders gold medal for 1941 by the A.I.M.E.

Dr. J. V. N. Dorr has been elected to receive the Perkin Medal of the Society of Chemical Industry for 1941. The medal is awarded annually for valuable work in applied chemistry.

C. H. Mace has returned to the United States from Brazil, where he spent several months supervising the blowing in of two new Mace smelters in the State of São Paulo, one of which was erected by the government.

G. A. Joslin, consulting mining engineer, has changed his professional headquarters from 1200 Rives-Strong Building, Los Angeles, to 311 Financial Center Building, in the same city.

Robert S. Lewis, of the Mining Department of the University of Utah, has returned to Salt Lake City after spending part of the summer visiting mines in Arizona and New Mexico.

G. L. Mill, mill superintendent of the Kelowna Exploration Company, Ltd., Hedley, was recently in Ecuador, and was expected to return to British Columbia some time in the current month.

D. L. Dowie, mining engineer with Bewick, Moreing & Company, of Melbourne, Australia, has resigned to enlist in the field engineers of the Australian Imperial Force.

Robert Crooks Stanley, chairman of the board and president of International Nickel Company of Canada, Ltd., has been named as the first recipient of the Charles F. Rand gold medal by the A.I.M.E.

Alan Bateman, profesor of economic geology, Yale Univerity, returned via plane at the end of September from a trip to Venezuela.

R. N. Hammon, metallurgist at the Raub Australian gold mine, Raub, Pahang, F. M. S., has resigned and returned to Australia. He has been succeeded by **A. J. Bell,** formerly of Enterprise of New Guinea, Wau, N. G.

R. W. A. Cox, formerly general manager of Siamese Tin Syndicate, Ltd., St. Helens, Tasmania, has gone to Penang to take up a position with the same company in the East, where it operates a group of tin dredges. Operations at St. Helens have ceased.

Carlos Aramayo, who has extensive interests in Bolivian tin production, recently arrived in Miami, Fla., en route to Washington, D. C., to confer with other industrialists regarding the establishment of a tin-smelting industry in the United States.

Lewis A. Grant, for some time identified with lead and zinc production in the Coeur d'Alene district of Idaho, recently accepted the position of superintendent at the Grandview mill, in the Metaline mining district, Pend Oreille County, Oregon.

R. L. Kidd has resigned his position as assistant professor of ore dressing research, University of Utah, and is now at Placerville, Idaho, investigating the possibilities of treating low-grade ores of that district.

Jay A. Carpenter, director of the Nevada State Bureau of Mines and of the Mackay School of Mines at Reno, has spent some time at Boulder dam in connection with a study of the application of Boulder power to mining in Nevada.

R. D. Gilbert, who contributed to our June, 1940, issue an article on the gold deposits of the Paracale-Mambualo district, Island of Luzon, in the Philippines, has completed his contract with Gumaos Goldfields, Inc., and is now at 15c Pinaglabanan, San Juan, Brazil.

Julian B. Beaty, of New York, president of Granby Consolidated, visited the company's Copper Mountain mine last month in company with **A. S. Baillie,** vice-president and general manager. Mr. Beaty succeeded the late **Nathan Amster** as head of Granby.

Edwin Spark, superintendent and agent for Balmer Lawerie & Company, Ltd., of Bengal, India, is spending a vacation in British Columbia and is taking advantage of the opportunity to visit some of the more important mines.

T. C. Botterill, of Vancouver, left recently by plane for British Guiana, where he will assume the managership of Cuyuni Gold Field. Mr. Botterill was latterly mine superintendent of Base Metals Corporation at Field, B. C.

Dr. Donald F. MacDonald, professor of geology at St. Francis Xavier University, Antigonish, N. S., is now serving as geologist-engineer with the Panama Canal Commission, a position which he also held while the canal was building.

C. E. Osborn has returned to the United States from the Philippine Islands, where he was mill superintendent at the Capsay mine, operated by Mine Operations, Inc., at Manila. He can be reached care of A. H. Johnson, Morrison, Colo.

Frank Ayer, for some time general manager of Roan Antelope Copper Mines, Ltd., and Mufulira Copper Mines, Ltd., Luanshya, Northern Rhodesia, will on Nov. 1 become consulting engineer to the companies named. **R. M. Peterson,** manager of Mufulira, succeeds Mr. Ayer as general manager of both Roan Antelope and Mufulira.

W. B. Gillies and **Fred Jordan,** of Youngstown, Ohio, affiliated with Youngstown Sheet & Tube Company, inspected mines in the Lake Superior district recently and were accompanied by **W. A. Rose** and **W. H. Prescott, Jr.,** of Cleveland, Ohio, of the firm of Pickands, Mather & Company.

D. C. Jackling, recently spent several days in Nevada, inspecting the open-pit mines, concentrator, and smelter of the Nevada Consolidated Copper Corporation, before leaving in company with **J. C. Kinnear,** manager, to attend the Colorado Springs meeting of the Western Division of American Mining Congress.

D. M. Kelly, vice-president of Anaconda Copper Mining Company; **C. E. Weed, J. J. Carrigan,** and **R. H. Sales,** also of the Anaconda staff; and **Dr. F. A. Thomson,** President of Montana School of Mines; **E. R. Bordcherdt, A. M. McDonald, E. P. Shea,** and **L. H. Hart** attended the regional meeting of the A.I.M.E. at Salt Lake City on Sept. 10-15, as members of a large delegation representing the Butte, Mont., region.

Richard J. Lund, Editor of *Mining Congress Journal,* has been appointed assistant group executive in the mining and mineral products division of the Advisory Commission to the Council of National Defense. Mr. Lund's duties will deal with coordination of work relating to a wide variety of minerals—both metals and non-metals—in the defense program. In this work he is associated with Dr. C. K. Leith, consultant on minerals to the commission, and with R. C. Allen, H. K. Masters, H. C. Sykes, and E. Vogelsang, specialists on strategic mineral commodities.

Cemal Biron, Bahri Ersoz, Ali Kozak, Cihad Onbulak, Selim Ozsahim, Server Tasdemiroglu, Suphi Yavasca, Sulhi Yungul, and **Kerac Eray** have been enrolled as students at Montana School of Mines. They had previously attended the Ecole des Mines, in Paris, and the mining academy at Freiberg, Saxony. They have been in the United States since last December, and having acquired an adequate command of English, began

their college work on Sept. 30, at the expense of the Turkish Ministry of Education.

Captain Oliver Lyttelton, former controller of the non-ferrous metals division of the British Ministry of Supply, and a well-known figure in the metal industry, has been appointed president of the Board of Trade. Appointment to this high post in the British Government followed an announcement issued on Oct. 3 that Sir Andrew Rae Duncan, president of the Board of Trade, has been elevated to head the Ministry of Supply.

David H. Newland, State Geologist of New York, has resigned as geologist of the State Museum. Dr. Newland was born in 1872 and was educated at Hamilton College, Munich, Heidelberg, and Columbia. In 1897 he was engaged in literary and scientific work and in 1904 he became associate editor of *Engineering and Mining Journal.* He entered the State service in 1905, remaining till 1920. After a period of private work, he re-entered the State service in 1927 and remained until his retirement.

Robert I. Jaffee, of Chicago; **Leonard Russell Hayes,** of Hamden, Conn.; **Marriott W. Bredekamp,** of Washington, D. C.; **James Grant Hayden, Jr.,** of Westernport, Md.; and **Francis Miles Bower,** of Mount Rainier, Md., have been designated to receive appointments to cooperative fellowships at the University of Maryland by Dr. R. R. Sayers, director of the Bureau of Mines, and Dr. H. C. Byrd, president of the University of Maryland. The fellowships are a part of the program of cooperation by the Bureau and the University of Maryland.

Dan E. Feray, of Beaumont, Tex., has been awarded a fellowship in the Montana School of Mines. Other graduate students who were awarded fellowships and assistantships for the present academic year and who began work on Sept. 1 are: **Jack L. Taylor,** of Banning, Calif., fellow in mineral dressing; **Wilbert E. Warnke,** Custer, S. D., assistant in metallurgy; **William F. Zelezny,** Lonepine, Mont., fellow in metallurgy; **Don E. Harvey,** of Butte, Mont., fellow in mining; **Robert A. Wilson,** Butte, assistant in mineral dressing; **Will Mitchell,** Butte, assistant in chemistry; **Lloyd L. Thompson,** Mabel, Minn., assistant in chemistry; and **Ernest E. Thurlow,** Rapid City, S. D., assistant in geology.

F. E. Wing writes us from Tacoma that this year he has prospected through southern California, western Arizona, parts of Nevada, and, during the summer season, in the Cascades in Washington. The net result has been the staking of ten claims in the Copper Lake basin, 3 miles in an airline southeast of Silverton, in Snohomish County, Wash., or 8 miles by trail. The claims are known as the Silver Horseshoe group. Four outcrops of high-grade vein material have been noted. These are about 600 ft. apart and in granite, and several hundred feet from the country rock. According to Mr. Wing this country has been represented as badly faulted and patchy, but he says considering how close the patches are, he has decided that he will see the work through.

OBITUARY

Amor F. Keene, a mining engineer, died at Douglas Manor, Queens County, N. Y., on Sept. 25 at the age of 60.

Herbert E. Samms, a mining man for many years associated with the industry in Idaho, died at Wallace, in that State, on Sept. 5 last, at the age of 48.

Sir Harold Carpenter, metallurgist, former president of the British Institute of Metals and the Institution of Mining and Metallurgy, died at Swansea, England, on Sept. 14. He was 65.

James Perry Watson, long president of the Mining Corporation of Canada and active in mining circles in the Dominion for more than a quarter of a century, died on Sept. 10 at the age of 78.

John H. Tresider, 65, master mechanic of Oliver Iron Mining Company in the Hibbing-Chisholm district of Minnesota, died on Sept. 14 last. He was born in Michigan and had been with the Oliver company for more than half a century.

Dr. Bruce C. Freeman, geologist and professor at Ohio State University, died early last month in the Abitibi region of Quebec, while acting as the director of a geological party conducting investigations in that area. He was 40 years old.

Frank A. Moss, one of Western Australia's best known mining engineers, died recently in Perth, W. A. Born at Mount Barker, South Australia, in 1862, he spent his earlier professional life with Broken Hill Proprietary Company, Ltd. In 1893, he went to Western Australia, where he was closely connected with the rise of the State as a gold producer and with the early development of the Kalgoorlie field.

Sir Abe Bailey, mining man, soldier, industrialist, and philanthropist, died on Aug. 10 at his home in Muizenberg, near Capetown, South Africa, at the age of 75. He was born in Cape Colony, educated in England, returned to South Africa in 1881 and had been prominently identified with its industrial, civic, and political development over a long span of years. He served in the Boer War and the first Great War. Sir Abe was created a baronet in 1919, and is succeeded by his son, **John Milner Bailey.**

George F. Utter, a prominent mining engineer and mine owner of Duncan, Ariz., died recently in that city, at the age of 56. Mr. Utter had been active in the development of mining in Arizona for more than 25 years, and was highly esteemed by a host of acquaintances in the industry. A friend of prospector and down-and-outer alike, his passing will be mourned by all familiar with his fine qualities of mind and heart. He was considered by many as the foremost mining engineer of the region in which his interests were centered. He is survived by his widow, Mrs. George F. Utter.

Sir Robert Abbott Hadfield, metallurgist, inventor, and writer, to whom the world owes the credit for the production of manganese and silica steel and many other alloy steels and metallurgical applications, died in London, England, on Sept. 30 at the age of 81. He was chairman of Hadfields, Ltd., and a director in many important industrial corporations. His technical literary productions have for long been esteemed as highly authoritative and comprised more than 200 papers, and his work, "Metallurgy and Its Influence on Modern Progress," is a standard reference. He was a member of many societies and scientific committees. Sir Robert was knighted in 1908 and created a baronet in 1917. He had been awarded many honors in practically every civilized country. The company of which he was chairman employed more than 15,000 workmen in the first World War.

Joseph H. Portugal, a consulting mining engineer with wide international experience and connections, died at Colon, Panama, on Sept. 10 at the age of 56. Mr. Portugal had been making an exploration trip into the interior of Panama. He received his B.S. degree at the Lycee of Geneva and completed his engineering studies at the University of Louvain, Belgium. In 1905 he was engaged in mineral exploration in the Belgian Congo. From 1921 to 1925 he operated gold and diamond placer deposits in British Guiana. In 1928 he was manager of a Patiño property in Bolivia, and from 1932 to 1936 he tested and managed properties in Montana, Nevada, California, Oregon, North Carolina, and South Carolina. He had returned to the Americas several months ago, after having passed two years in China as a government consulting mining engineer and metallurgist. During the first World War he served as a captain of ordnance and chemical warfare. He was sent to Italy after the Armistice as a member of the American Commission to Negotiate Peace.

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A LETTER

Gold Deposits of the Paracale-Mambulao District

The Editor:

I AM WRITING to congratulate you and Mr. R. D. Gilbert on the article entitled "Gold Deposits of the Paracale-Mambulao District" published in the June issue of *E.&M.J.* I am not a student of Philippine geology, and not particularly interested in that part of the world. The article mentioned, however, was written in such a manner that it could hardly fail to stimulate the interest of any geologist who happened to read it. A common failing of technical men, especially geologists, is to confuse the issue completely with a lot of pseudo-scientific verbiage when more simple language could express their ideas more fully and have less tendency to confuse the reader. Mr. Gilbert was unusually successful in conveying his theories with a minimum of scientific expressions and yet with sufficient technical phraseology to clarify the article for the technically minded reader. I hope to see more articles of a similar nature.

FRED W. BECKER

Kingman, Arizona.

What Metal Statistics Show

HEAVY DEMAND for copper, lead, and zinc during September, coupled with rising metal prices, has encouraged mine operators to plan increased production during the remainder of the year. Stocks of refined copper in September are expected to show another decline and zinc statistics for that month reveal the small stocks available. Zinc-smelting capacity is the bottleneck of the industry, and producers are taking steps to improve this situation by rehabilitating old furnaces and adding to present capacity to handle the increasing volume of concentrates. Refined lead stocks are low, but the large volume of foreign lead ready to enter this country serves as a source of supply if circumstances require it for our national defense program. The strike at the Selby lead smelter in California is still unsettled.

Discussion continues in Washington about a domestic tin smelter. Jesse H. Jones, Federal Loan Administrator, recently said, "We do not want to build a smelter unless we can get a constant supply of ore."

The August statistics of the Copper Institute show stocks of refined metal at the end of the month of 198,730 tons, a decline of 17,093 tons compared with the month previous. Stocks of blister copper decreased 925 tons during August, making the net decline in total stocks 18,018 tons.

Deliveries to domestic consumers increased from 71,226 tons in July to 96,383 tons, the highest for the year to date. Exports of copper totaled 1,561 tons, against 3,532 tons in July.

The duty-free copper statistics for the first eight months of 1940, in short tons, follow:

	Production	
	(a) Crude	Refined
January	89,598	80,501
February	76,145	82,761
March	85,796	86,295
April	84,366	80,964
May	82,682	86,029
June	79,845	86,077
July	(b) 79,327	90,995
August	79,926	80,851
Totals	657,685	674,473

	Deliveries to Customers		
	Domestic	Export	Totals
January	91,428	13,117	104,545
February	63,215	9,594	72,809
March	64,376	7,517	71,893
April	68,665	2,974	71,639
May	69,467	7,018	76,485
June	61,716	3,439	65,155
July	71,226	3,532	74,758
August	96,383	1,561	97,944
Totals	586,476	48,752	635,228

	(c) Refined Stocks End of Month
February	145,393
March	159,795
April	169,120
May	178,664
June	199,586
July	215,823
August	198,730

(a) Mine or smelter production or shipments, and custom intake including scrap. (b) Corrected. (c) At refineries, on consignment and in Exchange warehouses, but not including consumers' stocks at their plants or warehouses.

Monthly sales of copper by producers for delivery to United States consumers, in short tons, follow:

	1939	1940
January	15,399	24,987
February	23,361	147,112
March	28,618	29,305
April	59,874	41,701
May	59,026	83,879
June	66,786	110,453
July	183,151	58,577
August	38,299	67,281
September	183,877	254,976
October	68,423	.....
November	51,630	.....
December	28,798	.....
Total	807,242	.....

▶ LEAD—The refined-lead statistics for the months of July and August, according to the American Bureau of Metal Statistics, in tons, follow:

	July	August
Stock at beginning	55,343	47,360
Production:		
From domestic ore	35,343	36,851
Foreign and secondary	9,253	10,763
Totals	44,596	47,614
Domestic shipments	52,569	51,643
Stock at end	47,360	43,321

Shipments of refined lead to domestic consumers, in tons, by months:

	1939	1940
January	40,189	39,875
February	34,421	39,176
March	40,871	46,353
April	37,903	46,496
May	40,124	46,919
June	38,710	49,904
July	42,636	52,560
August	45,025	51,643
September	59,889	.....
October	66,060	.....
November	64,365	.....
December	44,881	.....
Total	555,074	.....

▶ QUICKSILVER—Production of quicksilver in the United States during July amounted to 3,200 flasks, the highest rate recorded since the beginning of the European war, according to the monthly report of the Bureau of Mines. Exports during July, regulated by license since July 2, fell to 1,031 flasks, against 1,383 flasks in June and 2,277 flasks in May. Domestic consumption for July was estimated at 2,200 flasks, 200 flasks less than the quantity indicated for the preceding month. Imports for consumption during July were nil. Supply and demand during July were virtually in balance.

▶ ZINC—The August and September statistics of the American Zinc Institute, covering all grades, are summarized as follows in tons:

	August	Sept.
Stock at beginning	58,796	44,670
Production	49,939	53,119
Production, daily rate	1,611	1,771
Shipments	(a) 64,065	(b) 66,824
Stock at end	44,670	30,965
Unfilled orders	69,508	95,445

(a) Includes 2,935 tons exported.
(b) Includes 4,023 tons exported.

Figures on operations of the Prime Western division alone, for the first nine months of the year (January to September revised), in tons, follow:

	Production	Shipments	Stock At End
January	19,930	25,240	24,742
February	22,542	20,017	27,267
March	23,846	20,401	30,712
April	21,742	20,034	32,420
May	21,173	24,292	29,301
June	19,392	23,143	25,460
July	20,698	26,139	20,019
August	21,224	27,774	13,469
September	22,873	28,986	7,356

▶ MANGANESE — Domestic production of manganese ore containing 35 per cent or more of manganese during the month of July was 2,700 long tons, against 2,600 tons in June, according to the monthly manganese survey by the Bureau of Mines. Shipments of domestic ore totaled 2,900 tons, against 2,300 tons in the previous month, and stocks in producers' hands amounted to 2,300 tons.

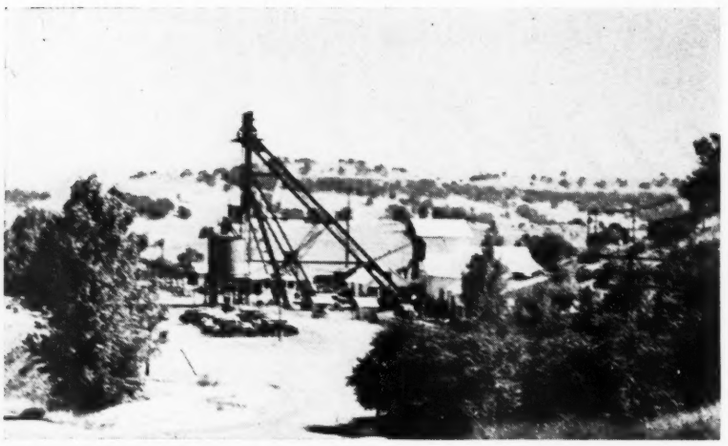
▶ TUNGSTEN—Jesse H. Jones, Federal Loan Administrator, announced Sept. 25 that as a part of the national defense program the Metals Reserve Company has agreed to buy from the National Resources Commission of China tungsten ore to the value of $30,000,000. The ore is to be delivered over a period of years at prices to be agreed upon from time to time, in accordance with market conditions, as the tungsten is delivered. "To assist China to meet her present foreign exchange needs," the official announcement stated, "the Export-Import Bank has agreed to lend China $25,000,000 that will be liquidated through the sale of the tungsten."

E & M J Weighted Index of Non-Ferrous Metal Prices

(100 is composite for 1922–3–4)

1929	110.33	1934	69.59
1930	82.87	1935	74.66
1931	60.20	1936	73.45
1932	48.26	1937	90.86
1933	59.79	1938	73.67
		1939	77.71

	1938	1939	1940
January	75.56	77.12	80.85
February	73.43	76.89	77.23
March	72.41	77.09	77.94
April	71.19	74.79	77.19
May	69.15	73.61	77.68
June	67.55	73.17	78.85
July	72.95	71.95	76.72
August	73.94	74.88	76.71
September	74.70	83.07	79.40
October	77.61	84.25	....
November	78.36	83.80	....
December	77.13	82.89	....



New surface plant at the old Eureka mine at Sutter Creek, California. A new and modern all-steel change house was recently completed to accommodate 200 men at this property

CALIFORNIA

Tungsten and Quicksilver Mines Start Production

New plant to concentrate tungsten ore completed in Pine Creek area—Abbott mercury property reopened — Crosscut 6,000 ft. long completed in Murchie mine

▶ Construction of a new tungsten concentrating plant has been completed at the property of Tungstar Corporation in the Pine Creek area of Inyo County, about 20 miles from Bishop. Treatment involves two-stage crushing, screening, grinding, and table concentration. A magnetic separator is available for removal of garnet. The mill was erected under contract by the Western-Knapp Engineering Company, of San Francisco. About 42 men are employed at the property under the direction of W. B. Lenhart, general superintendent.

▶ Production has been started at the Abbott quicksilver mine, on the eastern border of Lake County, near Wilbur Springs, Colusa County, which has recently been reopened by International Metals Development, Inc., Mark Ewald, president. Surface plant equipment and buildings include a furnace, diesel power plant, hoisting machinery, ore bins and oil storage tanks, bunkhouse, and office building. J. W. Wenzel is superintendent, and 35 men are employed.

▶ Yuba Consolidated Gold Fields, F. C. VanDeinse, vice-president in charge of operations, has started test work to determine values and operating methods on placer holdings in the Mooney Flat, Timbuctoo, and Smartville areas of Yuba County leased recently from the Interstate Land Holding Company.

▶ Development work is under way at the Ortega mine, near Mariposa, Mariposa County, acquired a short time ago by the Mariposa Commercial & Mining Company. The company is headed by Judge Charles W. Slack, Alaska Commercial Building, San Francisco, and D. Mullins, who has been in charge of the property for the past eighteen months, is general superintendent.

▶ Atoliaburg Placer Mining Company is constructing a dry-washing plant on placer holdings in the Stringer district near Randsburg, Kern County, following extensive test work. The plant is designed to handle from 400 to 600 cu.yd. of material a day, with mining done by an 8-yd. Carryall. N. Baxter and C. C. Mayfield direct operations.

▶ A 10-stamp mill has been placed in operation at the Alpha mine, in the Goodyears Bar district of Sierra County, by Rare Minerals Mining Company, after completion of a comprehensive development program. Thomas Collins is general manager.

▶ The 6,000-ft. crosscut driven from the 400 level of the Murchie mine, near Nevada City, Nevada County, to the North Banner mine has been completed, and drifting on two veins encountered during the work is now in progress. The properties are operated by Empire Star Mines Company, Ltd., with R. J. Hendricks, general manager, in charge.

NEVADA

Tin Ore Found in Jumbo Extension Mine

Samples taken from old Velvet Shaft—Tungsten and antimony deposits receive attention—Gold Rock Mining Company increases mill capacity

▶ Samples of ore taken from the 800- and 900-ft. levels of the old Velvet shaft of the Jumbo Extension mine, at Goldfield, sent to the United States Bureau of Mines and to Western metallurgists for analysis and said to be famatinite ($3Cu_2 S. Sb_2 S_5$), were said to assay as high as 2 per cent tin. An examination and sampling have been conducted by D. F. Hewitt and Ward Smith for the United States Geological Survey.

▶ The Nevada-Massachusetts Company, operating near Mill City, Pershing County, and largest United States producer of tungsten, has purchased a 300-acre tract of tungsten-bearing ground lying in the Humboldt River valley at Golconda, southeastern Humboldt County. A 50-ton pilot plant is to be provided for a special treatment process. Ott F. Heiser, manager, has his main office at Lovelock, Nev.

▶ Antimony mines and prospects are being reopened or prospected in several Nevada districts. Most noteworthy are old mines at Bernice, Churchill County; Big Creek, Lander County, and in the Antelope, Relief and Black Knob districts in Pershing County. The Fencemaker mine, at Black Knob has been acquired by Miss Alma Priester, of San Francisco, who has a crew of men engaged in development, with headquarters at Lovelock.

▶ Gold Rock Mining Company, organized lately to acquire patented claims and a mill near Silver City purchased by Noble H. Getchell, vice-president and manager of the Getchell Mine, Inc., has increased mill capacity by addition of a 4-ft. Marcy ball mill, classifier, hydraulic jig, and flotation cells. Victor Jacobson is in charge

▶ Placer claims embracing 5,600 acres in the Sawtooth district, on the Humboldt-Pershing County line, have been acquired by location and under long-term option by O E. Chaney, of Reno, and California associates. The greater part of the area has been held by J. G. Huntington and C. H. Griffith, who have leased small sections to "snipers" and small operators using dry washers. From this work a substantial amount of alluvial gold has been recovered. Testing is in progress at a number of points, with prospects that two or more dragline dredges may be provided.

▶ At the old Crown gold-silver mine, in the Adelaide district, 12 miles south of Golconda, in Humboldt County, a new 150-ton cyanide mill has been completed by Roy A. Hardy, in charge.

▶ With recent completion of the Union Pacific spur track from Pioche to the Caselton shaft of the Combined Metals Reduction Company, provision has been made for immediate construction of a 450-ton mill employing selective flotation. Heretofore shipments of zinc-lead-silver ore have been made at the rate of around 200 tons per day to the company's concentrator and smelter at Bauer, Utah. E. H. Snyder, of Stockton, Utah, is president and manager of Combined Metals, which is controlled by the National Lead Company.

▶ A caterpillar-mounted dragline unit and land dredge of 1,200-cu. yd. daily capacity have been ordered for use of the newly organized Empire Mining Corporation on a 2,200-acre tract on Bodie Creek, western Mineral County, where test work has been conducted with satisfactory results. Equipment includes also a bulldozer and power shovel, Pan-American jigs, and amalgamating plates. The company is headed by Robert F. Wright, of Syracuse, N. Y. Ben H. Donnelly is manager, living at Hawthorne.

▶ With the payment of Dividend No. 22, disbursements of the Getchell Mine, Inc., attained in August a total of $1,170,000.

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Near Patagonia, Santa Cruz County, Ariz., is the Trench lead-zinc mine of the American Smelting & Refining Company. Above is a general view of the Josephine shaft, crushing plant, and the 200-ton flotation plant near the mine

ARIZONA

Christmas Copper Mine Being Developed

Ore is shipped to Hayden smelter—Custom mill of 25-ton capacity is constructed to receive ores from Patagonia and Gold Hill districts

▶ The Christmas Copper Corporation, of Christmas, is shipping approximately 80 tons of mixed sulphide and carbonate ores daily to the Hayden smelter. The ore is being taken from upper workings which were thought to be exhausted. Development work is being followed on the 600- and 800-ft. levels. About 30 men are employed. Sam and Frank P. Knight, Jr., of Christmas, have the mine under lease.

▶ A 25-ton flotation mill has been constructed on the Patagonia highway a mile north of Nogales and a test run made. Ore from the Proto mine is being treated. A. R. Russell and C. C. Robertson are operating the plant and will receive custom ores from a number of small properties in the Patagonia and Gold Hill districts.

▶ California parties have taken an option on the San Pedro group of manganese claims 13 miles south of Winkelman. Burns Given and Orson Branch, of Winkelman, own the property.

▶ The Big Bug Dredging Company, of Prescott, has began placer mining on Big Bug Creek. A dredge is being moved to the property. Operations will be under the direction of C. S. Barnes, and five or six men are employed.

▶ Discovery of a deposit of mill-grade graphite in the Gerbat Mountains 12 miles north of Kingman, in Mohave County, by Guy Atlee and Lucky Kay, was recently reported. The graphite zone is said to be eight to ten feet wide and about a thousand feet long.

▶ Two flasks of mercury are being produced daily from the Ord quicksilver property, at Slate Creek near Tonto Basin. The mercury product is sold to California customers. About 30 men are employed with J. D. Hill, mine superintendent. L. E. Foster, Box 776, Phoenix, Ariz., is general manager.

▶ A strike of tungsten ore is reported to have been made by G. A. Westerdahl and N. D. Cothran 38 miles east of Kirkland. Shipments of ore have been made to Tucson.

▶ Nevada interests are sampling the Bi-Metal mine, owned by J. P. Cleator, near Cleator. Additional ball mill and flotation equipment are to be installed.

▶ The Tennessee–Schuykill mine, at Chloride, is shipping about 35 carloads of zinc and lead concentrates monthly. The zinc concentrate is shipped to Amarillo, Tex., and the lead concentrates go to El Paso, Tex.

▶ The Miami Copper Company, at Miami, is operating seven days a week since it has acquired an additional water supply from the old Dominion mine. It is reported that a record run of 17,000 tons of ore in one day was recently made. The old Dominion copper mine was closed many years ago because of the excessive cost of pumping water from the lower levels.

▶ Charles Houghton has leased the Golden Rule gold-silver-lead mine owned by Mrs. Edith Jackson, of Benson. The property is a mile south of Manzora siding near Dragoon, Ariz. A two-drill compressor has been installed and also a 30-hp. hoist.

▶ Victor Verity, of Tucson, is operating the old Democrat gold-silver mine in the Hualpai Mountains 25 miles south of Kingman. Pete and Mike Vukoye are the owners of the property and are also carrying on the development work. A 300-ft. tunnel on the property has been cleaned out and extended an additional 200 ft.

▶ The Manganese King group of claims near the Bill Williams River in Yuma County has been taken over by option to purchase by A. H. Vaughn, of 2314 East Oak St., Phoenix. Plans for diamond drilling of the property are being made.

▶ N. G. Perkins, of Fresno, and John Burrell, of Hanford, Calif., have leased the Virginia group of gold-silver-lead claims near Quartzsite. A crosscut from the 170-ft. tunnel will be driven to prospect ground below surface showings.

MONTANA

Several Gold Placer Areas Being Tested

Natomas Company is conducting drilling program near Confederate Gulch—Green Mountain Mining Company constructing new mill

▶ Placer testing is reported at several points throughout the State. J. Brown, representing the Ring interests of Chicago, is conducting tests near Maiden. The Natomas Company of California, under the direction of Lester L. Shanahan, is drilling near the mouth of Confederate Gulch. Wilson Placers, near Hassel, are being equipped for operation by A. H. Douglas, of Townsend. Also, a group of St. Paul men has acquired about 250 acres of placer lands at Boulder Bar and part of Confederate Gulch. Preparations to conduct operations are under the direction of Peter Lametti. Revived activity in the upper part of Bear Gulch near Garnet is also reported, and recently conducted tests are believed to indicate an operation there in the near future. Dry-land dredging operations are in progress on Sauerkraut Gulch near Lincoln. Kenneth Egan and associates, of Helena, are conducting this work.

▶ Construction of a new 50-ton flotation plant at the Drake mine of the Green Mountain Mining Company near Dixon is in process. This property, under the management of Earl F. Estone, of Dixon, has been a steady shipper of copper ore for several years, during which time general development has been directed toward establishing a milling resource. The ores, which occur in a gabbro dike, are unusual for this region in that they contain, in addition to copper, gold, and silver, important amounts of platinum, palladium, and iridium.

▶ The Geological Survey, United States Department of the Interior, as a part of its strategic minerals investigations, has prepared a report on the chromite deposits of the eastern part of the Stillwater Complex, in Stillwater County, Mont. Trenching made it possible to trace segments of a tabular body of chrome ore with an aggregate length of 5,660 ft. in a distance of 9,000 ft. along the strike. The average width of the ore body is 5½ ft., but at the east end a zone of disseminated ore 430 ft. in length averages 29½ ft. in width. All the ore will need concentration, as the estimated average content of chromite is approximately 50 per cent. Although no high-grade metallurgical ore is to be expected, it is clear from this study of a small part of the Stillwater Complex that a large tonnage of submarginal ore can be recovered in time of need.

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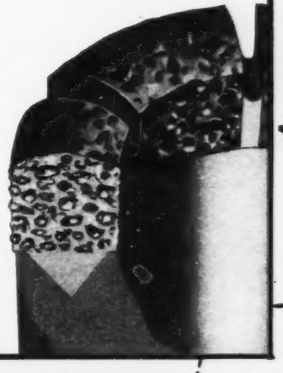

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NEWS FROM Washington

By Special Correspondent

CONTRACTS for government purchase of defense materials are being made in a multitude of ways. Some are outright purchases of goods, through competitive bids according to the usual government routine. The other extreme of contract arranges for the building of a plant at government expense, for government ownership, but with a plan for private company operation at government expense.

Various contract forms are being used between the two extremes described. All involve what might be called semi-subsidy of production. This subsidy is usually necessary in order to encourage industry to make plant expansion not normally needed for non-military production. In some cases the expansion consists mainly in speeding up of production, with a resulting higher unit cost. The way in which the government undertakes to assume the extra costs or compensate for extra risk is adjusted to the need in each case.

The War Department has announced the following summary of contract awards made by the various supply arms and services under the 1941 appropriations up to and including Sept. 14, 1940:

	Week Ended Sept. 14, 1940	Period July 1, '40–Sept. 14, '40
Air Corps	$7,069,618	$186,571,687
Chemical Warfare Service	4,730,000	21,678,108
Engineers	19,267,314	38,457,541
Medical Corps	280,058	1,670,681
Ordnance Dept.	203,409,611	600,717,825
Quartermaster Corps	67,828,161	223,013,792
Signal Corps	8,117,122	30,563,489
Coast Artillery	5,877	64,803
Totals	$310,707,761	$1,102,737,926

The Tin Situation

EVEN those most pessimistic about the chance for building a stockpile of tin have been greatly encouraged by the progress during August and September. The following paragraph, officially released Sept. 20 by the National Defense Advisory Commission, shows the basis of the new hope:

"A record total of 12,400 long tons of the metal, or about twice the amount ordinarily consumed in a month, arrived in the country during August and at the end of the month there were 22,364 long tons afloat to the United States. By Sept. 14 the Navy, the Procurement Division of the Treasury, and the Reconstruction Finance Corporation, through the Metals Reserve Company, had purchased 13,694 long tons of tin under the government's stockpile program and more than 8,000 tons already had been delivered."

The long shadow of the Mikado which has darkened the prospect in Indo-China is a factor of growing importance. The fear that Japan may either inadvertently or intentionally stop movement of tin to the United States prevents recent success from becoming untempered optimism.

There has been continuing effort on the negotiations for development of a domestic tin smelter program. Up to late September these arrangements had not crystallized to the point of any official action. The latest opinion appears to be, about as formerly, that Uncle Sam will have to put up the money and take all the capital risk if a new smelter is built. This does not imply a lack of industrial cooperation. But it does reflect the fear that continued flow of either Bolivian ore or concentrates from the Far East may not be assured for such new venture.

Despite the hope that rationing may never be necessary, officials in many of the government units continue to study the ways in which a limited tin supply might be distributed with a minimum over-all difficulty for industry.

Small Mine Loans

LEGISLATION which had long been sought in Congress for special loans to small mining companies became a law by Presidential approval in mid-September. This legislation authorizes R.F.C. to increase its commitments on ore deposit exploitation when use of an initial $20,000 loan gives promise of successful development. Formerly a second loan was not authorized under normal conditions, but now a second $20,000 can be advanced on attractive prospects of this sort when R.F.C. believes that this is expedient.

Other small borrowers in the mining industry are likely to be helped even more by revision of S.E.C. rules and regulations under way during September. Changes proposed have been submitted to many industrial and trade association critics for comment. If adopted the new regulation would greatly simplify the problems of firms desiring to issue securities in the amount not exceeding $100,000. In effect, the new rules would provide exemption from many former requirements of banking and report detail, and would permit more regional-office action. Those mining enterprises which require small security issues from time to time may wish to study the new proposals for rules 220 to 222 inclusive. The S.E.C. will furnish material of this sort and will welcome prompt comment or criticism. The original proposal that all such advice come in by October 15 does not represent an actual deadline.

Tax on Strategics

AS THE SENATE passed the bill imposing new excess profits taxes there was included an amendment proposed by Senator Pittman, of Nevada, to exempt certain mining income from these levies. The text of that amendment was: "Income derived from the mining, reduction, or beneficiation of tungsten, quicksilver, manganese, platinum, and antimony, chromite and tin, or the ores and material containing such metals, shall not be subject to the excess profits tax provided for in this act."

The purpose of this amendment was, of course, to continue the encouragement of new developments of strategic metals and minerals without the fear that substantially all possible profit would be taken by the tax collector. Such curtailment of profit opportunity would, mining state spokesmen point out, practically prevent the industry from taking unusual risks in the exploitation of possible strategic resources. That kind of discouragement is not to be tolerated when every effort must be made on any strategic resource promising commercial usefulness.

In this connection Washington is debating whether or not a similar British tax on corporations may not become a factor in determining how much tin can be bought by Uncle Sam from British possessions in the Far East. One theory is that new profit from increased tin operations would go 100 per cent to the British tax collector. Thus enlarged activity to meet American stockpile demand would result in increased work, increase risk, depletions of reserves, and absolutely no monetary reward to the mining industry. Despite that claimed difficulty, there has not yet been experienced in Washington any clear evidence that the British tin producers are unwilling to do their best to supply Uncle Sam's stockpile. Furthermore, it is anticipated that real evidence of such difficulty would probably suffice for clarification of the situation through diplomatic channels. The British Government, Washington hopes, would not stand in the way of some reasonable reward to these firms for much needed extra effort in tin supply.

Industry Spokesman

AS HE ASSUMES THE POST of Secretary of Commerce, in addition to his duties as loan administrator, Jesse Jones describes himself as the member of the Cabinet who is to be the spokesman and representative of business and industry in Washington. He points out that labor and agriculture, and to a limited extent other units of American activity, have their advocates in high places in the Capital. He intends to make a comparable post for business, including mining.

Noting this attitude, Washington observers are reminded that the last Secretary of Commerce clearly to take such a stand was Herbert Hoover. One commentator, apparently speaking the mind of Washington, suggested: "Jones will do well to take Herbert Hoover as a pattern in this new responsibility."

This discussion of the function of the Secretary of Commerce is stirring some quiet comment as to the political implications inevitably involved. It is pointed out that politically it is often expedient to work, and to vote in Congress, for such social units as labor, agriculture, or even the transportation agencies. But mining, manufacturing, and trade too often remain political whipping boys. They are, it appears, still safe objects of disparaging comment when vote-getting rather than fact-finding is the prime objective. Under these circumstances, some doubt is expressed as to whether Mr. Jones will be able to proceed very far on his plant as spokesman and advocate.

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Excess Profit Tax

MINING as well as the rest of industry is going to be much burdened by new defense taxes. Some of these burdens may bear more heavily on some divisions of the mining industry, especially small units or those experiencing large fluctuation in their activities. Spokesmen for the industry in Washington have emphasized these special problems and the hoped-for proper relief exemptions.

Much of the difficulty expected may come from the fact that "excess" in profits is calculated by comparison with a base period 1936-1939. Many of the mining units were small, at a low level of activity, or even non-existent at that time. American Mining Congress has led much of the industry effort to have proper provisions for fair calculation of the levy on such enterprises. Some of the types of relief hoped for have been: The use of three of the four years named as a base period when one year was one of deficit or low activity. Exemption of the first $10,000 of profit from this special levy. Permission to use a short base period for companies recently organized. Exemption from excess profits tax for new developments required for government purposes—for example strategic materials.

Regardless of these features of excess profits calculation, all the mining industry will undoubtedly pay higher base rates. The need to increase government income, partly offsetting the tremendous defense spending, places this burden on all industry. The proposal of 24 per cent (as the Senate passed this bill) may not be the highest imposed next year, as there was already talk in Washington during September about the need for still higher taxes on business to pay Uncle Sam's new bills.

For "Total Defense"

CONSCRIPTION OF MEN is only a part of the present program of Washington. There is much loose talk about conscripting wealth, commandeering of plants, seizure of goods, and requisition of this or that. The actual program is much simpler than this glib talk would indicate, and apparently much more sensible than some of the talkers.

Export embargoes have held up the movement from the United States of certain goods previously consigned to foreign purchasers. In some cases there is no ready means for the original shipper to regain control of the goods and reconsign them in the United States. Washington wants authority for suitable proceedings of seizure. Otherwise urgently needed things, machine tools for example, might lie unused on the docks, no good to the foreign purchaser owner and unavailable either to shipper or prospective U. S. user.

Other seizures of goods in course of manufacture may occasionally occur under unusual circumstances. The Navy Department has most precisely defined circumstances which may make necessary official action. That Department refers to the part of the conscription act which empowers the President to conscript industry as well as men, and by Navy official release says:

"Having complete faith in the voluntary cooperation of industry, the Navy Department does not expect to invoke this law for that purpose. The law may be used, however, to conscript those materials or commodities under contract for delivery to non-essential purposes. The conscription in this case will obtain the materials for national defense and relieve the owners from prior contractual commitments. The law will, therefore, be used for the protection of industry and to make it possible for industry to cooperate with the Department."

Actual seizure of plants is not expected soon. In the first place, industry is really cooperating. In the second place, the mere knowledge that a plant could be seized if the government did not get some measure of help, will in itself make the seizure highly improbable. In the third place, there are very few circumstances under which either Army or Navy executives would want to go to this much trouble, because some alternative source is generally easier to use than a plant under recalcitrant management.

Conscription of wealth, compulsory subscription to public bond issues, and other matters like that have not yet been reached in either the tax or the defense financing programs. They require Congressional action. The occasional "wild" comments on those subjects necessarily assume that Congress is going to be stupidly extreme in legislation still to come. That there must be a plan for total defense is generally agreed; but the official management to be expected is nothing like as radical as the gossip about Washington lobbies might imply.

News "Fines"

Bonneville Aluminum—Manufacture of aluminum for national defense began at Vancouver, Wash., with power from Bonneville Dam on Sept. 20. Washington officials heralded this "new industrial life for the entire Pacific Northwest," and urged that other mineral and metal industries come out to use this cheap power. Even the critics of the idea of Federal operation of industrial enterprise agree that this particular tie-up has greatly accelerated increased aluminum output for the government by private industry.

Training Workers—Both for expanding industry activity and to replace workers who may be lost in the military conscription program, executives are urged to undertake promptly new training programs. The Defense Commission has a special unit to cooperate in the up-grading of junior workers so that they can take more responsibility throughout various industries as they go into increased activity. Training for better service as well as for increased responsibility is being actively assisted by this government agency. Working under labor leader Sidney Hillman is C. R. Dooley, an experienced industrialist. Also getting organized is a new unit in the Office of Education which will have means for financing universities and technical colleges in their part of the college-grade training needed to supply more personnel. Those experiencing shortage of either labor or specialists are to have generous assistance, and the training units will even have some money subsidy where necessary.

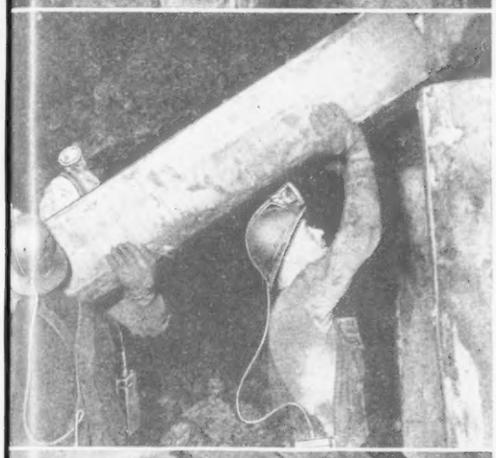
Draft-Men's Rights—Employers of young men taken into military training must consider responsibilities of reemployment, protection of seniority, insurance and social security privileges, and other rights granted by law. Incidentally, taking of these men from busy mining industry projects is to be expected if the local boards so judge, and no let-down in labor standards or overtime limits can be expected.

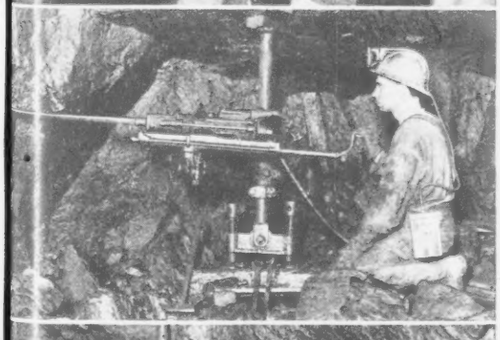
Sabotage Safeguards—Any mining enterprise doing business important to the national defense may request the Federal Bureau of Investigation to help. That sabotage-prevention agency will, if conditions warrant, make a survey to detect any weak spots in plant set-up or protective measures. Specially trained sabotage agents are available to assist company executives; and all of the proceedings will be entirely confidential. This service is not available everywhere, but is rendered where important Federal interest is found.

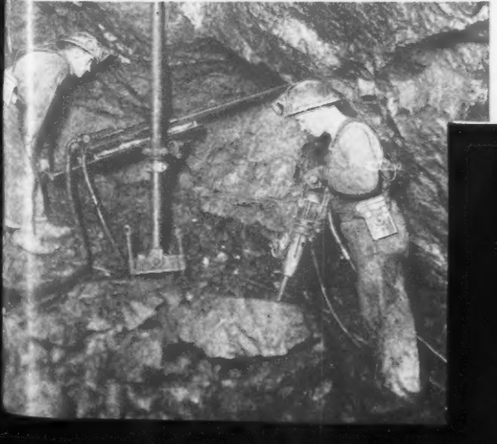
More Quicksilver—Announcing new rural power plans, Rural Electrification Administration expresses the hope that quicksilver production will double or triple in Southwestern Arkansas. Eighteen cinnabar mines in that area of Pike and Clark counties are to be electrified as a part of the R.E.A. project financing the Southwestern Arkansas Electric Cooperative of Texarkana.

Hemisphere Plans—The mining industry may become involved in some of the hemisphere programs. These are being organized in an effort to give more stable economy to Latin American neighbors. Grave difficulties have been encountered in the cases of meat and wheat from the Argentine and with Brazilian coffee. There is some fear that the Chilean nitrate or perhaps the Chilean copper questions will be similarly difficult. Generally speaking, however, enlarged mineral and metal production by the Latins will be stimulated, largely without interference with domestic supplies. This result is to be expected because of the emphasis on such things as strategic minerals and those normally imported to the United States from more remote sources than Central and South America. The politics of these problems affects the other countries quite as much as the United States. This became evident when a distinguished Argentinean on return from the United States announced that the President had assured him of favorable prospect for meat import from the Argentine "after elections." The Washington denial was, of course, prompt, since even those desiring to encourage Western Hemisphere alliances realize that there are important political limitations on the programs to which the Senate must give approval.

Price Controls—Amazingly harmonious effort is being achieved by industrial advisors on defense and New Deal price watchers. It appears that heavy-goods prices, with one or two exceptions, have not fallen under suspicion as to unreasonableness. Consumer goods prices are giving more trouble, and Miss Harriet Elliott, who is their policeman, is causing some worries in the food and related industries.







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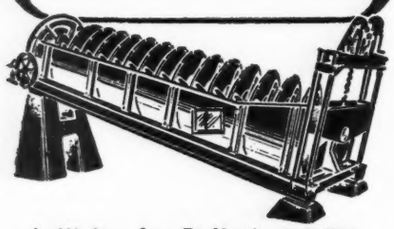

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Metal Mining Convention Attracts Large Attendance

Seventh annual meeting of Western Division of American Mining Congress crystallizes sentiments of industry on many vital problems

DEVOTING its major attention to mineral problems relating to national defense, and to Federal legislation affecting the mining industry, the American Mining Congress held its seventh annual metal mining convention and exposition at Colorado Springs, Colo., Sept. 16-19. Attendance of operators and exhibitors was estimated at 1,600. The exposition of mining and metallurgical equipment was the best yet held, and attracted a large audience. A separate report on the new products exhibited at the convention will be found on page 87.

The rôle of minerals in the present war was outlined by Dr. C. K. Leith, authority on strategic and critical minerals, who is serving as an advisor to the National Defense Commission. "The United States is better supplied with minerals than any other country on the globe," said Dr. Leith, "but we still lack in whole or in part a considerable number of minerals which we class as strategic. The problem of national defense is to keep industry supplied for its rapidly expanding requirements and at the same time build up Government stockpiles against an emergency when the flow from outside may be restricted or stopped. The general plan is to build up about a two-year supply in Government stock over and above industry stocks. Allowance is made for all possible domestic production. Only such supplies are being bought as cannot be produced from domestic sources with reasonable certainty and within a reasonable time."

The current status of strategic minerals in the United States was presented by E. W. Pehrson, Economics Branch, Bureau of Mines. Briefly, tin offers the most serious problem, but the situation is not alarming. There is good prospect of acquiring from 50,000 to 75,000 tons of Asiatic tin within a year, and a domestic tin-smelting industry is likely to be established to treat Bolivian ores. The outlook for manganese is satisfactory, and a two-year supply is almost in sight. Stockpiling of chromite is proceeding slowly, but the domestic outlook is improving. Tungsten stocks have not grown much, because consumption has increased along with production. Mercury production has been stimulated by high prices, so that the country is self-sufficient with respect to this metal. Nickel and antimony offer no major procurement problems.

War's effect on domestic production of metals was reviewed by E. R. Dondorf, for lead; Howard I. Young, for zinc; H. L. Pierce, for iron ore; Worthen Bradley, for mercury; and Charles H. Segerstrom, for tungsten. All reviewers emphasized the radical change in conditions since the first World War. They expressed satisfaction with domestic production and prices, and with the ability of the domestic mining industry to meet any demand made upon it.

Mining geologists had their day at the convention and made the most of it. Ira B. Joralemon outlined the rôle of mining geology in searching for great and small orebodies, and in examination of new mines or prospects. Each of these three types of problems demands its own geological methods, and the geologist who has his client's interests at heart will govern his work accordingly. The growing importance of mining geology in mineral development was discussed by Edward Thornton, general manager, Summitville Cons. Mines; George M. Fowler, consulting geologist; and F. A. Thomson, president, Montana School of Mines.

Two sessions that attracted the largest audiences dealt with the effects of Federal legislation on mining. Edmund M. Toland, formerly general counsel to the Congressional committee investigating the National Labor Relations Board, summarized the conditions revealed by the investigation, which he characterized as a "shocking indictment of public officials sworn to uphold the Constitution of the United States in the performance of their duties." Instance after instance was cited to show the rottenness and crookedness of the Board and its employees. At another session Col. Philip B. Fleming, wage-hour administrator, discussed the wage-hour law and tried to defend its application to the mining industry. Vigorous opposition developed in discussions by E. T. Zook, of California, and H. L. Faulkner, of Alaska.

Other sessions were devoted to health and safety, public relations, new developments in mining and milling, and taxation.

Resolutions were passed expressing the sentiments of the American Mining Congress on a number of subjects, including national defense and the mining industry, employer-employee relations, taxation, and Congressional control of Federal expenditures. The following principles, embraced in the declaration of policy a year ago, were reaffirmed: State control of water pollution and mine inspection, development of minerals on public lands and utilization of mineral deposits in national parks and reservations, ratification by the Senate of reciprocal trade agreements, opposition to St. Lawrence waterway, and coinage and circulation of gold. A resolution was also passed in memory

of James F. Callbreath, first secretary of the Congress, recognizing his service of more than 30 years.

COLORADO

Manganese Deposits in Leadville Studied

Long tunnel would permit unwatering of several mines in this district — Demand for zinc increases activity in Montezuma area

▶ Charles F. Jackson, chief of the mining division of the United States Bureau of Mines, says that in connection with the strategic minerals investigations now being conducted by the Bureau of Mines, consideration has been given to Leadville, as a possible source of manganese that might be made available for use under circumstances of national emergency. As many of the mines have been shut down and flooded, the information desired cannot be obtained by sampling, but from study of old maps it is estimated that 2,000,000 tons of manganiferous ore containing 10 per cent to 35 per cent Mn, and 2,000,000 tons of manganosiderite containing 14 per cent to 20 per cent Mn, remain in the Leadville district. Thus a tunnel over 38,000 ft. long has been discussed, with the portal near the Thompson Gulch, as a means to unwater the mines, instead of pumping.

▶ The set domestic price for silver and the growing demand for zinc are largely responsible for the increased activity in the Montezuma section of the State. The Continental Leasing Company has started rehabilitating the Pennsylvania tunnel, with George Calloway as manager. Other activity consists of work on the famous Argentine or Decatur mine, the Brittle Silver part of the Ruby mine; and the Bullion mine, on Collier Mountain.

▶ Carlton Deep drainage tunnel made an excellent record of advancement during August, in that the bore was advanced a total of 1,738 ft., with a daily average of 56 ft. and a total advancement on Sept. 1 of 20,091 ft.

▶ The Lamartine silver mine and mill, on Trail Creek, 5 miles southeast of Idaho Springs, and at an elevation of 9,600 ft., are mining and milling about 75 tons every 24 hours.

▶ Ward United Mines, at Ward, have installed an electric driven pump, as the old pumps were insufficient and the mine, which was flooded, has been pumped out. Mr. Emmons is in charge of the operations.

▶ According to Merrill E. Shoup, president of the Cresson Consolidated Gold Mining & Milling Company, that company shipped 31,440 tons of ore in May, June, and July, with an average gross value of $10.03 a ton. The mine was recently closed, because of the necessity of replacing timber shaft set with steel.

▶ W. A. Howell, manager of the recently opened manganese mine near Snowmass, about 15 miles from Aspen, reports excellent progress at the mine. About 25 men are employed.

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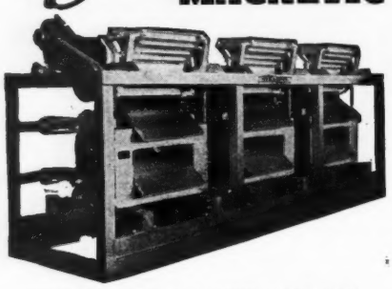

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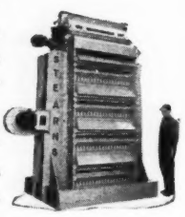

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Technical and Economic Problems Discussed at A.I.M.E. Meeting

Among subjects on program at Salt Lake City were Ore Deposits of Utah Copper, mining, milling and molybdenite recovery operations, and the future of lead and zinc markets

THE A.I.M.E. REGIONAL MEETING held at the Hotel Utah, Salt Lake City, Sept. 10–13, had an unusually good attendance, member registration totaling around 650. Entertainment included a special welcome luncheon, field trips to Ironton, Tintic, Park City, Midvale, and Tooele, an all-day field trip to the Utah copper mine, Magna mill, and Garfield smelter, followed by a banquet at the Hotel Utah. W. J. O'Connor, manager of the Salt Lake operations of A. S. & R. Company, was toastmaster.

The opening day, Tuesday, Sept. 10, was devoted largely to Student Associates affairs, the morning session being presided over by D. Frank Nisbet, chairman of the organization, and the speakers included D. C. Jackling, H. G. Moulton, president, A.I.M.E., and John M. Boutwell. Mayor Ab Jenkins said a few words of welcome. Colonel Jackling, in his paper "The Ever-Expanding Opportunities and Usefulness of Technical Education in the Field of Mineral and Metallurgical Industry," declared that the industry offers a wider scope of opportunities today than it did a generation ago, pointing out recent developments, such as deeper exploration, alloying of metals to increase their usefulness, thereby adding to the usable mineral resources, and improving methods of extraction. He emphasized that the men most likely to grasp opportunities are those who have technical education plus experience plus the initiative to do something new. In regard to the recent proposal for unionization of mining engineers, Colonel Jackling warned that such a measure would be disadvantageous both to the individual and the profession, contending that engineers should rely on their abilities rather than on organized coercion. Speakers at the noon luncheon, D. D. Moffat, presiding, included Gov. Henry H. Blood, Mayor Ab Jenkins, and President Moulton.

The Wednesday and Thursday morning sessions were devoted entirely to technical matters, with E. W. Engelmann, general superintendent of mills Utah Copper Company, in the chair. John M. Boutwell, consulting mining geologist, read an interesting paper on the ore deposits of Utah, explaining the geology of the three major and several minor Utah mining areas, production, and future possibilities. A detailed picture of the Utah Copper Company operations was given by four members of the operating staff. James A. Marsh, geologist, explained the geology of the Bingham area and the Utah copper mine, disclosing the discovery of a geological structural feature of the district not heretofore recognized and indicating probable presence of productive limestone deposits. Mining, milling, and molybdenite-recovery operations were described by Louis Buchman, general superintendent of mines, E. W. Engelmann, and A. G. Johnson, metallurgical engineer. The Wednesday session was concluded with the reading of the paper "Progress of Slushing and Methods of Ground Support at Climax" by F. S. McNicholas, assistant general superintendent. Milling practice at Climax was described by E. J. Duggan, mill superintendent.

Principal speaker at the Thursday session was Clinton H. Crane, president, St. Joseph Lead Company, who spoke on the future of the lead-zinc industry. After citing production and consumption figures, smelter capacities and other pertinent data, and the effect of the present war on both industries, Mr. Crane expressed the view that at the end of present hostilities lead and copper might be in an immediately better position than zinc, due to the possibility of a large overproduction of zinc by smelters now under blockade. Mr. Crane was followed by F. R. Milliken, chief metallurgist, General Engineering Company, who described the Ohio Copper Company's tailings re-treatment plant at Lark, Utah. Smelting practice at the McGill plant of Nevada Consolidated Copper Corporation was explained in a paper read by Leonard Larson, superintendent of reduction works, and Gloyd M. Wiles, vice-president and general manager, Park City Consolidated Mines Company, described development and dewatering practice at the company's property near Park City.

In the evening members and their wives were guests of the Utah Copper Company to celebrate Galena Days at the R. C. Gemmell Memorial clubhouse. The Regional Meeting Committee included D. D. Moffat, general chairman; W. J. O'Connor, vice-chairman; F. S. Mulock, reception; R. A. Pallanche, registration; J. O. Elton, finance; M. D. Paine, entertainment; Louis Buchman, Bingham committee; James Ivers, field trips; Gloyd M. Wiles, hotels; E. W. Engelmann, technical program; and J. W. Wade, publicity. Mrs. O. N. Friendly was Women's Auxiliary chairman.

West Virginia University To Have New School of Mines

▶ Plans and specifications have been completed and construction has been started on a new six-story Mineral Industries Building at West Virginia University, Morgantown, W. Va. This important addition to the University will supply a long-felt need and contribute greatly to the mining industry. The building will house the school of mines, the chemical engineering department, the department of geology, and

the State Geological Department. President Charles E. Lawall, himself a former director of the school of mines, and D. L. McElroy, present director, say they hope to begin use of the building at the opening of the 1941–42 term.

UTAH

Elton Tunnel Starts On Last Mile

Long project is expected to be completed in six months—New shaft to be sunk on the Tintic-Utah property near Eureka

▶ The last mile of the Elton drainage and transportation tunnel near Tooele has been started upon. National Tunnel & Mines Company, controlled by the International Smelting & Refining Company, reports that the bore was advanced 641 ft. during the first three weeks of September, and 1042 ft. in the 30-day period. At this rate, the 24,300-ft. tunnel tapping Bingham mining properties should be finished within six months.

▶ The Tintic Standard Mining Company paid 5c. a share dividend on Sept. 30, a total of $57,004, making a grand total of disbursements amounting to $18,152,000. The company also announced that independent leasing operations had been resumed in the Iron Blossom and the Eureka Lilly mines. State and Federal labor laws still prevent leasing operations in ground operated by mining companies.

▶ Gifts totaling $2,500 to encourage young men seeking education in the fields of mining and metallurgy were announced by Col. D. C. Jackling, president of the Utah Copper Company, at the banquet Sept. 13 closing the regional meeting of the American Institute of Mining and Metallurgical Engineers in Salt Lake City.

▶ Diamond drilling is being carried on by the Mercur Dome Mining Company on its 500-level to cut three fissures opened on the 300 level. The Apex Standard Mining Company at Eureka is drifting on its 900 level before sinking a winze to prospect for a gold orebody.

▶ Ore carrying $35 a ton in gold has been struck by the Langson brothers in the upper workings of the Wasatch Gold Mines, Inc., property, Big Cottonwood Canyon, Manager C. S. Woodward announces. Shipments are to start at once. The company is driving a 3,000-ft. tunnel at an altitude of 8,400 ft. to strike the downward extension of the ore being mined 2,000 ft. above.

▶ The Tintic Ophir Mining Company will resume sinking its winze at the 2,000-ft. point in its main tunnel as soon as the machinery damaged by fire this summer is repaired.

▶ New ore developed on the Moscow Silver property, near Milford, by a 75-ft. tunnel, carries high values in silver, the management announces. Ore is being shipped from the 150-ft. level.

▶ The Rainbo Gold Mines Corporation has installed two diesel engines, a compressor, a blower, air lines, an electric

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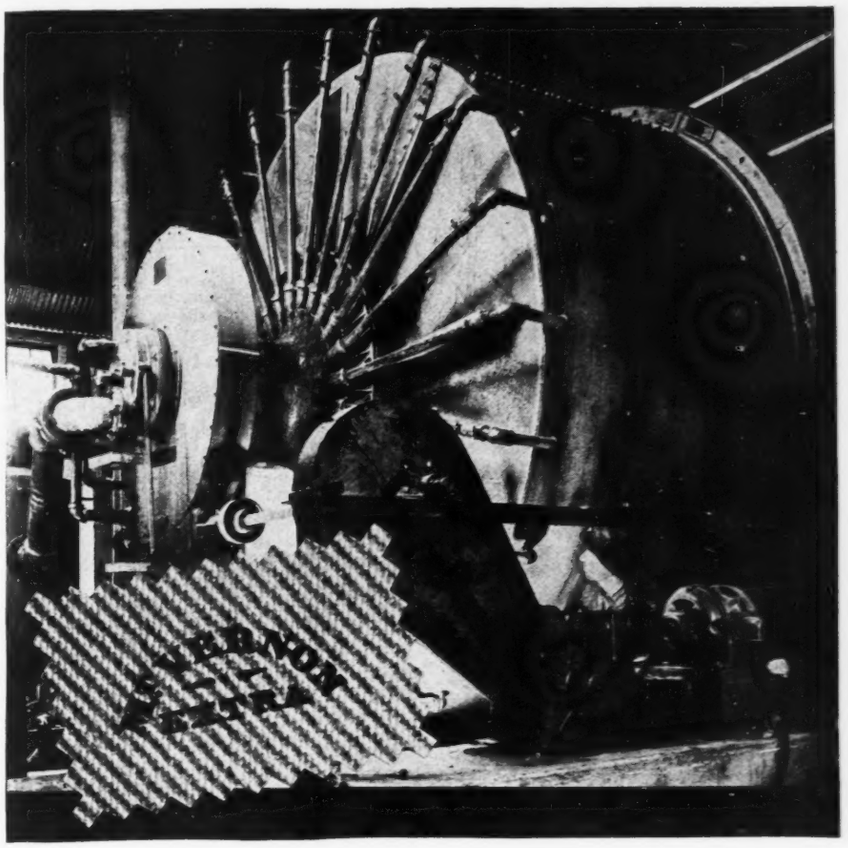

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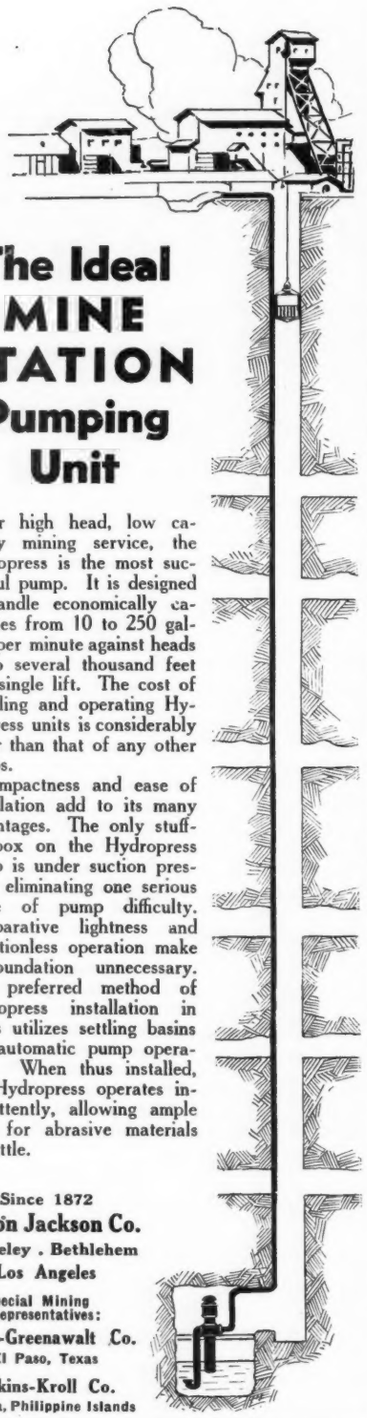

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generator, and other equipment at its property 5 miles west of Marysvale. Ore being mined in its 3,800-ft. tunnel is being shipped. Harvey D. Heist, of Salt Lake City, is consulting geologist and Patrick T. Henry, of Marysvale, is president.

▶ The first carload shipment from the orebody opened up on the 1,300 ft. level of the New Quincy mine, at Park City, carried 23 oz. of silver to the ton and 5.1 per cent zinc.

▶ Officials of the Tintic Sovereign Mining Company—Robert H. Dunsmore, president; Carl W. Buehner, vice-president; and S. M. Woolfe, of Salt Lake City—announce that the company will sink a new shaft on the Tintic-Utah property near Eureka.

IDAHO

Large Gold Dredge Starts Operations

Extensive area in Salmon River to be exploited—Hecla Mining Company speeds sinking of Atlas shaft

▶ The largest gold dredge in Idaho started operations late in September on the Yankee Fork of the Salmon River in Custer County. The dredge was built by the Bucyrus-Erie Company, of South Milwaukee, Wis., and the Olson Manufacturing Company of Boise, Idaho, at a cost of $500,000. It is being operated by a subsidiary of the Silas Mason Contracting Company, of New York. H. L. Meyers, vice-president, reported that a 15-mile stretch of territory has been cleared for dredging and that 30 men will be employed in day and night operations. Normal operating capacity is rated at 195,000 cu.yd. of gravel per month. Power is supplied by diesel engines.

▶ Hecla Mining Company has adopted a 24-hour day and a seven-day week at the Atlas property, in the Mullan district, to speed up sinking of the deep development shaft. L. E. Hanley, Hecla's president, expects to make in excess of 100 ft. a month and reach the first station at 400 ft. by Jan. 1. The new shaft and station are about two miles underground.

▶ Oakley Mining & Milling Company has started work on the Little Jewel group, near Oakley. A crosscut tunnel will be driven 500 ft. to open a surface outcrop of copper-silver ore. New buildings have been erected, according to President John H. Fairchild, Oakley.

▶ The Lemhi Flotation Company is building a new milling plant at Salmon for the treatment of custom ores. A Buda-Lanova diesel engine will furnish power for the mill. Arlin Davidson, of Salmon, and R. W. Leonard, of Boise, head the new compony.

▶ The Coeur d'Alene Antimony mine, in the Pine Creek district, has been leased by Sven Anderson, of Bonners Ferry, and Charles F. Dean, of Spokane. The property has a 5-ft. vein of antimony ore opened by a 300-ft. shaft and was the source of shipments during the first World War.

▶ West Star Mining Company, operating in the Burke district, is being reopened by James E. Markwell and Alexander Markwell. New buildings have been erected. Lead carbonates in a body 15 to 30 ft. wide have been exposed at the surface, according to J. H. Eby, Spokane engineer. The vein is the same as the Morning vein and the Star vein.

▶ Kimberley Gold Mines, Inc., near Grangeville, has opened the famous Crystal vein, according to Lou Wilcox, manager. About 48 in. of gold ore has been disclosed. A 50-ton flotation plant is being installed and will be operated this winter by Les Slater.

▶ Centerville, one of the old boom mining camps in the Boise basin area, will be razed by placer mining operations. The old townsite is located on a high bar of placer gravel, which Fisher & Baumhoff, Boise dredge operators, will exploit with power shovels.

▶ After 50 years of idleness, the Grand Prize lead-silver mine, near White Knob, is again being worked by William Roller, Bert Keller, Arch Flemming, and Ralph Erickson, of Tooele, Utah. New machinery will be installed.

▶ The drift on the 1,000-ft. level of the Liberal King shaft, Pine Creek district, west of Kellogg, broke into 7 ft. of zinc-lead ore on Sept. 23. Manager Henry Weber, of Rose Lake, said there was 3½ ft. of first-class ore and 3½ ft. of milling ore.

TRI-STATE

Many Zinc Properties Being Reopened

Higher price for metal brings sliding scale wage increase to miners—Shafts being deepened and some mines dewatered

▶ Advance of the blende price to $45 a ton early in September not only has resulted in wage increases to mine and mill employes of the Tri-State zinc and lead district but has stimulated activity in the mining field, which will bring about production gains in the near future. Since the latter part of August, major companies operating in the field have increased wages 50c. a day to the highest level since 1937. Many of the companies now are mining lower grades of ore reserves on the better prices.

▶ Eagle-Picher M. & S. is sinking a shaft on the Blue Goose lease, south of Cardin and midway between the See Sah and Southside mines, now being operated by the company.

▶ Federal Mining & Smelting has resumed operations on the Jarrett lease, a mile west of Treece, according to L. G. Johnson, of Baxter Springs, district superintendent for the company.

▶ Work of converting the old Commerce Blue Goose mill, southwest of Cardin, into an up-to-date plant for the re-

treatment of tailings in the immediate vicinity by the Big Chief Tailing Company, is progressing according to schedule and the property will be placed in operation early in October, according to Kenneth Neal, of Miami, company superintendent.

▶ Oklahoma Interstate Mining Company is dewatering the old Bingham lease, a mile south of Baxter Springs, in Oklahoma. An 8-in. Pomona turbine pump, powered by a 100-hp. electric motor, was installed in the shaft, which is about 240 ft. deep. C. F. Dike, of Joplin, is manager.

▶ Several old shafts are being reopened in the Oklahoma field, including the Long Hunt mill shaft, north of Quapaw, by Jesse Corneilson, of Baxter Springs, and associates; the Malsbury north field shaft, two miles northeast of Quapaw, by W. B. Kinder, of Hockerville; the Bingham No. 5, at Picher, by the Allen Mining Company; the east field shaft on the Waxahachie lease, two miles east of Quapaw, by James Osborne, of near Quapaw; the southeast field shaft on the Goodeagle lease, a mile southwest of Cardin, by the Hudson Lead & Zinc Company; and one on the Nevins land, near Lincolnville, by the Romo Mining Company.

▶ Oscar Told, of Joplin, Roy Jenkins, of Webb City, and Leslie Cahill, of Oronogo, are building a small mill underground on the old Hurry Up lease in the northwest part of the Webb City mining field, which will treat about 100 tons of ore and clean-up fines from the old underground workings.

IRON COUNTRY

Stripping Planned for Galbraith Mine

As season draws to a close operators make plans for work during winter months

▶ All operations on the Mesabi range are at capacity, and the season's shipments are now predicted to total around 62,000,000 tons. No changes have been made in rates of wages or hours and no labor troubles have been experienced at any of the mining properties. Consumption of iron ore has now reached a total of 5,500,000 per month, and if the strong demand for ore continues, a larger season is expected next year. Plans for winter work are being made, and prospects for a busy winter season are good.

▶ The Greenway mine, at Grand Rapids, Minn., operated by the Evergreen Mines Company, has made its initial shipments and will produce until the end of this season.

▶ Butler Brothers will strip the Galbraith-Sargent property, at Nashwauk, Minn. Approximately 1,500,000 cu.yd. will be removed to make the ore available for next season.

▶ Shipments of iron ore in September totaled 9,998,618 long tons. Total for the season to date is 48,235,227 tons.

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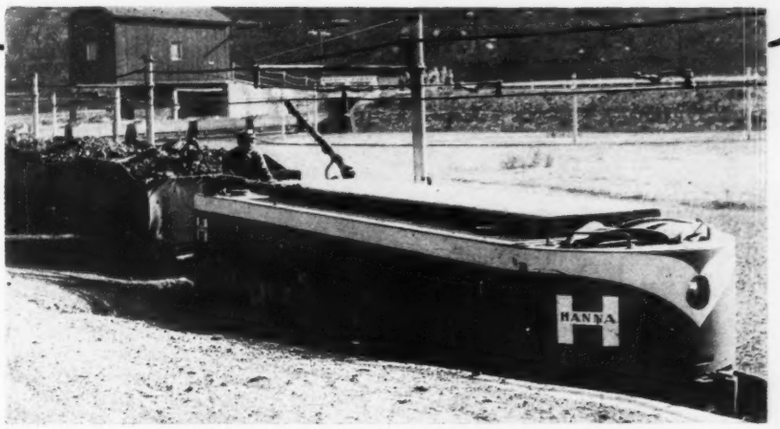

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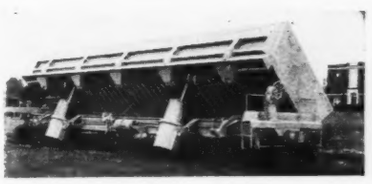

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MEXICO

Strike at Cananea Copper Ended

General increase in daily wage, pay for strike period, and economic concessions agreed upon for 3,000 workers

▶ Mining in Mexico jogged along with the advent of fall, but there were some favorable signs—Cananea Consolidated Copper, Cananea, Sonora, ended the strike on Sept. 10 that began April 5 by allowing a general daily pay increase of 60 centavos (12c.), several important economic concessions, and the payment of 600,000 pesos ($120,000) as wages during the shutdown, and The Fresnillo Company, Fresnillo, Zacatecas, smoothed out labor trouble by agreeing to provide 80,000 pesos ($16,000) to balance wages and make presents of 60,000 pesos to help its 3,000 workers to found cooperatives and otherwise improve their economic condition.

▶ British-owned Colima & Ransburg Syndicate, incorporated in California, J. L. P. Parkinson, general manager, will start sulphur exploitation late in October on deposits near Ciudad Guzman, on the borders of Colima and Jalisco. An initial daily output of about 300 tons is expected. This output is to be increased to around 600 tons during the winter. The property has been diamond drilled to 1,800 ft. with excellent results. After refining in San Pedro, California, the sulphur is to be shipped to Vancouver, Canada. The syndicate contemplates building its own plant at San Pedro.

▶ Cia. Minera Los Azules, S. A., Los Azules, Chihuahua, is soon to suspend operations because of unprofitable returns, it is reported. This action would deprive 400 workers of employment.

▶ Efforts are being made by the Federal Government to end sanguinary clashes between cooperative miners in various regions and prospectors who raid their properties. The cooperatives and companies are to be protected from ore thieves, who cause heavy losses, the government promises.

▶ Arasco's Santa Barbara unit, Chihuahua, was the victim of a curious theft, when an air compressor worth $2,400 was stolen. The thief, who was arrested, sold the compressor for $20 as scrap metal.

▶ New work contracts are expected to result from conversations between The Fresnillo Company, Fresnillo, Zacatecas, and its workers, that are being held under supervision of the Federal Labor Department.

▶ An important antimony sulphide deposit near Nogales, Sonora, is being worked by Gustavo Escobosa Tapia, Apartado Postal 99, Nogales. He is soon to install a small concentrating plant.

▶ Revision of work contracts at the following units of American Smelting has been urged upon the Federal Labor Department by the national miners'

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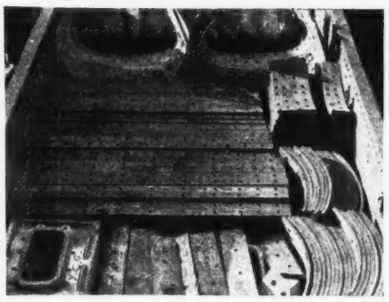

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▶ Teziutlan Copper (The Mexican Corporation) has sold its electric power plant at Teziutlan, Puebla, to a group of Spanish political refugees who are to establish a paper factory in the region and use the plant to service the factory.

▶ President Lazaro Cardenas has authorized the Federal commission for regulation of the prime necessity articles market to import 2,000 tons of 10-mm. corrugated iron to fill pressing needs for the product throughout Mexico. This iron is to be supplied at cost. Most of it will be imported from the United States.

▶ Announcement is made by the national commission for stimulation of the mining industry, Ing. Jose Laguardia, manager, Ing. David Segura, assistant manager, that it spent up to Sept. 16, 1,600,000 pesos ($333,333) for the establishment and equipment of the following metal-treatment plants for the service of prospectors and small-scale miners: Guanajuato, 13 kilometers from Guanajuato City in the Santo Niño and Cedro region, 150 tons' daily capacity, cyanide plant, 600,000 pesos; Tlalpujahua, State of Mexico, 50 tons, flotation, 300,000 pesos; Tecamachalco, Lomas de Chapultepec, Mexico City, 25 tons, cyanide, flotation, amalgamation, and facilities for lead and tin smelting, 360,000 pesos; Nacozari, Sonora, 50 tons, flotation and cyanide plant, 175,000 pesos; and Alamos, Sonora, 50 tons, flotation, both to be in operation by the end of 1940, and Altar, Sonora, 15 tons, flotation, 40,000 pesos.

CANADA

Gold Strike Made in Savant Lake Area

Ore said to be similar to Pickel Crow mine —Progress made at Steep Rock iron mines —New company plans development in Zeballos, B. C., district.

▶ The Savant Lake area, in the Patricia district of northwestern Ontario, has jumped into prominence following gold discoveries early in September by prospectors of the Northern Canada Mining Corporation. The rich showings are 16 miles north of the railroad and occur as pyrite replacement in dikes of iron formation cut by quartz stringers. A 15-ft. zone that resembles the ore at the Pickle Crow mine has been traced by trenches for a length of 2,000 ft. A second find on the Northern Canada property is also reported, half a mile west of the original strike. A group of claims adjoining the discovery ground has been taken over by Mining Corporation of Canada and other holdings have been acquired by Coniagas, Moneta Porcupine, St. Anthony, and other operating companies, in the vicinity of what is believed to be one of the most promising gold strikes in recent years.

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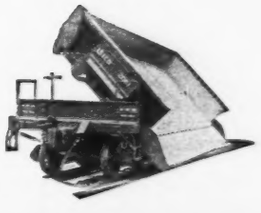

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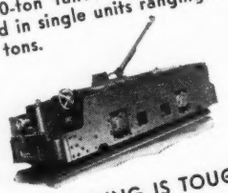

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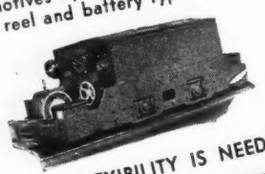

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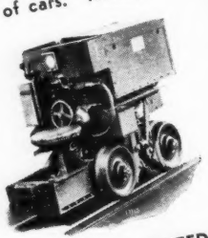

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▶CANADA

▶ Bonetal Gold Mines, controlled by Noranda and adjoining Hallnor, another Noranda operation in the east Porcupine camp, has been rapidly indicating new ore by diamond drilling along the strike of the north zone.

▶ Tombill Gold Mines, mining the west extension of Bankfield's main south ore zone, Little Long Lac area, is driving a long crosscut to test a zone 2,500 ft. to the north, on the eastward extension of the Jellicoe Consolidated orebody.

▶ Steady progress is being made with shaft sinking and diamond drilling at the hematite deposit of Steep Rock Mines. Serious water trouble interrupted underground work when a fault was intercepted below 800 ft. Heavy electrically driven pumps were operating at the end of September, when another attempt was made to drill horizontal holes into the main orebody from the 800 level. A series of diamond drill holes are being put down from Mosher Point to locate the downward continuation of the "B" orebody, located a mile south of the main "A" zone and traced for a length of 4,700 ft. by drill holes from the ice last winter. The grade is thought to average about 60 per cent iron across 110 ft. Drill hole No. 280 is now in progress.

Quebec

▶ With the completion of the 1,000-ft. shaft on the Cassels-Duval property, in Bousquet Township, the United States Smelting, Refining & Mining interests are ready for a program of intensive underground exploration.

British Columbia

▶ Under the direction of a new company known as the Zeballos Pacific Gold Mines, Ltd., the promising Gold Peak property at Zeballos, for many months tied up by litigation, will again undergo intensive development. According to J. A. Mackenzie, mine superintendent, development to date consists of 700 ft. of tunneling on the No. 3 vein. Work proposed by the new company is on veins Nos. 1 and 4 and one known as the "Brown Bomber" vein. The Gold Peak claims are situated in the center of the Zeballos producing area; on one side are the rich Spud Valley and Privateer mines, and on the other, the Mount Zeballos and the Rey Oro (recently renamed the C. D.). Officers and directors of the new company are: G. L. Fraser, president; Robert Fiddes, vice-president; Howard Forrester, M. L. A., secretary, and Campbell G. Thompson, treasurer. Mine superintendent is J. A. Mackenzie.

▶ Homeward Mine, Ltd., at Zeballos, is proceeding with installation of a 35-ton capacity mill at Homeward, approximately 5 miles beyond Central Zeballos, according to R. C. McCorkell, head of the company. This is the fifth such mill to be constructed in the Zeballos camp.

▶ Privateer Mines, Ltd., a Zeballos company, has taken an option for examination on a group of eight claims near

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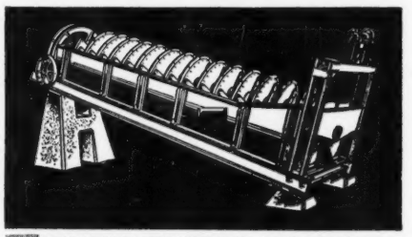

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Savona, in the Kamloops district. The group is said to have shown commercial possibilities as a producer of mercury.

▶ More careful sorting that was required to maintain desirable mill heads, which resulted in the installation of an improved washing and sorting plant completed Aug. 15, has already improved production returns of Spud Valley Gold Mines, Ltd., at Zeballos. Though the new plant was in operation only ten days of August, production figures for that month rose to $54,377 from the July output of $50,981. Officials anticipate an increase of 10 to 15 per cent in production.

▶ Assured ore reserves of Surf Inlet Consolidated Gold Mines, Ltd., on Princess Royal Island, are estimated to contain 25,000 oz. of recoverable gold, Charles Mentzel, of New York, consulting engineer, told shareholders at the company's annual meeting held in Vancouver. It is planned to intensify development to the north in the Surf and to the south in the Pugsley, on both the 900 and 700 levels.

▶ Stewart Canal Gold Mines, Ltd., is proceeding with the erection of a 12-ton mill on its property, one-half mile from Stewart, in the Portland Canal area. Electric power will be supplied by Pelton wheel and a tram and other necessary equipment have already been installed. Erection of the plant is under the direction of T. N. Youngs, who is in charge of the Prince Rupert government sampling plant.

▶ Additional exploration and investigation of outcrops on the Portland Canal property of Premier Border Gold Mining Co., Ltd., adjoining Silbak-Premier, will be undertaken this fall, A. E. Jukes, president recently announced.

▶ Placer activity in British Columbia's most northerly mining division, the Atlin district, is more pronounced than for many years. Northern Resources, Ltd., American financed company, has been granted two special placer leases by order-in-council at Victoria, one lease covering 5 miles on Pine Creek. The other lease comprises a similar distance on Consolidation Creek. The company plans to develop these leases on an extensive scale.

▶ The proposal advanced to employees of Consolidated Smelters through the Workmen's Cooperative Committee that the company increase the wage scale 3c. for each point rise in the federal government cost of living index over the index at March, 1938, which was 132, has been rejected by workers at Trail and Warfield. The plan would have been retroactive to June 1. A similar vote conducted at the Sullivan mill and at the Sullivan concentrator at Kimberley indicated a majority of workers there in favor of the scheme. Object of the proposal, as outlined by S. G. Blaylock, president of C. M. S., in a letter to employees, was to enable the company to take care of increases in the cost of living, thus relieving employees of their share of the war cost, with the exception, however, of increased costs imposed by taxation. A bonus of 25c. initiated in October, 1938, would have remained in effect had the new agreement been implemented.

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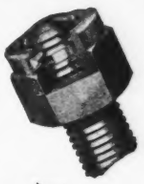

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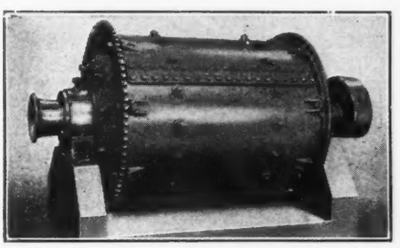

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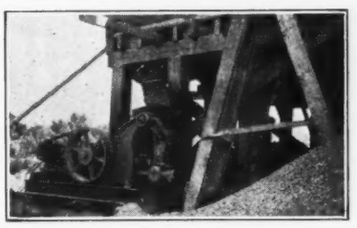

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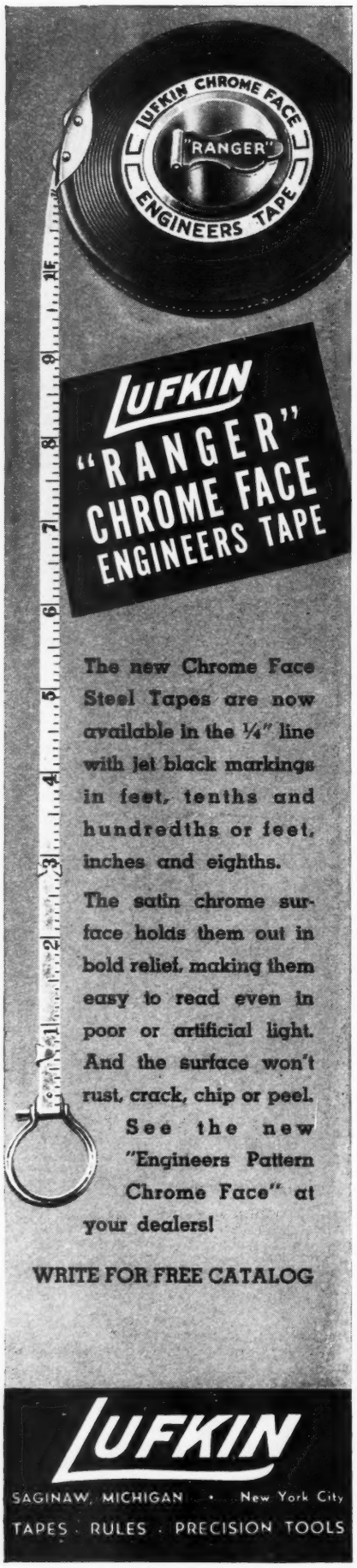
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AFRICA

Rhodesian Coppers Renew Government Contract

Three largest producers supply an additional 100,000 tons of metal to Britain—New monthly high in gold output is made on the Rand

▶ The contract under which the Rhodesian copper producing companies have supplied Britain's government with 265,000 long tons of copper during the past year has now been renewed for a further year, there being no change in either the amount or the prices. Evidently the 265,000 tons was assumed to be the total productive capacity of the three mines, Roan Antelope, Mufulira, and Rhokana. It is now reported that they have recently supplied the government with an additional 100,000 tons, this making it apparent that their production for the past year was not less than 365,000 tons, or 817,600,000 lb. This is greatly in excess of the most optimistic estimates of their output capacity. Prices of £43 10s. for blister and £48 10s. per long ton for electrolytic, the quotations which ruled immediately pre-war, are mentioned; but it is believed that a much higher price was paid for the extra 100,000 tons. The big increase of production undoubtedly gives the companies profits which will enable them to maintain last year's rate of dividends, despite the necessity of paying 100 per cent excess profits tax.

▶ In both the original contract and in its renewal there was provision for an advance in price in the event of rising costs of supplies, labor, and transportation. It is understood that there have yet been no sufficient cost increases to cause the companies to ask for higher prices. In fact, the companies are acting from patriotic motives, doing all they can to keep the government's expenses down and its wants supplied without unduly sacrificing the welfare of their shareholders. The same motive actuates the miners and is largely responsible for the great increase of output. There are some minor matters which await adjustment, like double taxation of the dividends paid by Mufulira, and a larger allowance for exhaustion of ore resources, but it is assumed that these will receive attention in due season.

▶ The Witwatersrand gold mines are continuing to set up new high records of production and profits almost every month. Output in July was 1,195,531 oz. and August indicated a new record of 1,199,699 oz. Twenty-one companies so far reporting having exceeded all previous records. The increases are being achieved by treating larger tonnages of slightly lower-grade ore, and by taking this lower grade as the standard, and by continuing development, ore reserves are generally being increased. Labor is plentiful, and the industry is in every respect in a flourishing condition. The exploration and development of new properties is continuing.

▶ The Union of South Africa is pre-

$2,000 REWARD

OFFERED FOR THE RECOVERY OF 124 FULL AND 15 PARTIALLY FULL, TOTAL EQUIVALENT 126 FULL FLASKS, PRIME VIRGIN MERCURY, STOLEN AT WOODRIDGE, NEW JERSEY, SEPTEMBER 7, 1940.

The amount of the reward will be reduced proportionately in the event that only a portion of the mercury is recovered.

$500 REWARD

offered for the arrest and conviction of the thief or thieves or of any person or persons criminally buying, receiving or withholding said property.

The total amount of reward which can be claimed under these offers is $2,500 in any event. These offers will expire noon December 31, 1940, and the undersigned hereby reserves the right to be sole judge of any and all disputes and to make any decision in connection therewith, which decision will be final and conclusive.

Should this property be offered to or seen by you, or should you obtain any information concerning it, notify us by telegraph or your local Chief of Police immediately.

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The Perfect Bit-Metal
Low temperature setting protects diamonds used in HI-CASTE Bits—and provides the lowest diamond cost per foot. HI-CASTE Bits are available in flat-faced and double-round-nose types. Also upon request, any other standard shape, size, wall thickness, or thread. Write for descriptive literature.
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OTTUMWA

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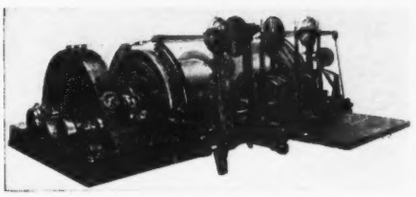
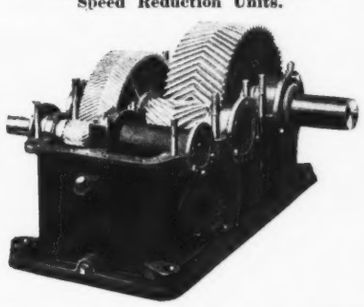


There is an Ottumwa Hoist to meet your particular requirements. The above hoist is equipped with band friction clutches, and hand operated brakes. Larger sizes are equipped with axial plate clutches and power operated brakes.

These hoists are equipped with the latest type of Control and Safety Devices.

Every hoisting problem has a correct solution. Ottumwa has the experience to work out the right solution for your hoisting needs. Call on us.

Electric, Steam Diesel & Gasoline Hoists.
Roller Bearing Trucks & Mine Cars.
Cages, Skips and Sheaves.
Herringbone and Spur Gears.
Speed Reduction Units.



Ottumwa Reduction Units and Speed Increasers equipped with Ottumwa-Sykes continuous tooth herringbone gears are available in all sizes and ratios. These units are rugged in design and are admirably adapted for mill and mine service.

The increased bearing surface and greater load carrying capacity of herringbone gears gives a greater factor of safety and longer life. Their accuracy makes them the most efficient gears known to-day.

In addition to gear units we are prepared to furnish gears in all pitches from 16 D. P., to 1¼ D. P., and all sizes up to 122" diameter, 24" face.

OTTUMWA IRON WORKS

OTTUMWA, IOWA, U. S. A.

In continuous operation since 1867.

paring to spend £46,000,000 on the war this year instead of the £14,000,000 previously intended. This necessitates a general increase of taxation. It is computed that of increases to yield an additional £4,825,000, the gold mines alone will contribute £855,000; but higher surtaxes on incomes which are largely from gold-mining dividends, together with various other taxes, may directly and indirectly increase this £855,000 to £2,000,000. The present state of popular feeling will probably prevent any protest being lodged by the mining companies. Efforts will rather be made to earn the additional money required.

▶ Gold Coast Main Reef has declared a maiden dividend of 5 per cent (3d). Bushtick, the company which resurrected a very low-grade property in Southern Rhodesia and had handled it with marked efficiency, has increased its dividend to 6⅔ per cent, this making 10 per cent out of the earnings of the year ended June 30. Burma Corporation has declared a final dividend of 3½ annas, against 5 annas a year ago.

AUSTRALIA

Strategic Minerals Supply Being Studied

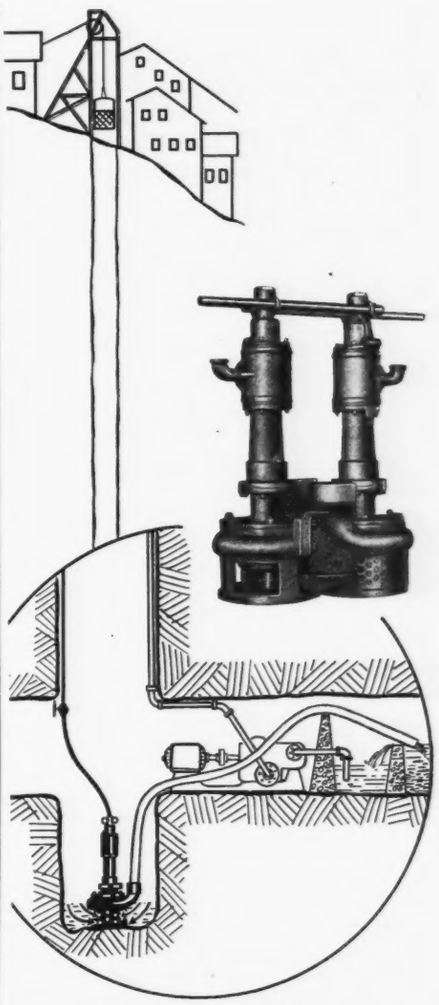
Manganese, antimony, and tin deposits to receive attention—Mount Morgan increases its copper production

▶ Latest report of the Northern Australia Survey, presented to Parliament recently, shows that activities are being concentrated on minerals likely to be of value in wartime. These include gold, copper, antimony, tin, manganese, mica, and wolfram. The Survey's work on gold has been mainly in the Tennant Creek, Granites, and Pine Creek regions of Northern Australia, where much has been done which has helped to swell the gold output of the Territory. Manganese deposits in the foothills west of Cairns, Queensland, are being examined, and the copper deposits of the Chillagoe district, in the same State and just over the Northern Australia border, at Redbank, are under investigation. Much good work has been done in the investigation of wolfram deposits in Central Australia, where the extension of known deposits and the opening up of new ones have been facilitated.

Western Australia

▶ Gold production is still on the increase, the yield for the first half of the year having been 597,556 oz., or 5 per cent more than in the corresponding period of last year. Production for July was 92,369 oz.

▶ After being idle as a result of litigation which extended over 2½ years, work is being started on the Hannan's Hill leases of Mount Charlotte (Kalgoorlie) Gold Mines, Ltd. Paringa Mining & Exploration Company, which is general manager in Australia for the Mount Charlotte company, plans to erect another 5,000-tons-a-month milling unit at the Paringa mine, and it is likely that Mount Charlotte development ore will be put through this unit, in



HERE'S THE PUMP FOR MOPPING UP and for Many Other Mine Uses

BYRON JACKSON 2-STAGE PNEUMATIC SPONGE

Here is the handiest and most economical pump ever developed for "mopping-up" and general utility work in mines. It operates on compressed air—lowers the water level to within 3 inches of the bottom of the shaft or sump—and lifts the water 300 feet. Handles sand and other abrasives with minimum wear—passes ⅝-inch solids. For lighter service the 2-stage can be separated, each stage operating as an independent unit. Capacities on 90-pound air pressure: 25 gpm at 300 feet; 40 gpm at 250 feet; 80 gpm at 200 feet; 100 gpm at 160 feet.

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MECHANICAL ENGINEERS:

Engineering degree from technical school in high standing required; major in mechanical or mechanical and structural engineering; high scholastic record; well-rounded experience, including some years in operations, engineering or maintenance in bituminous coal companies. Must be exceptionally resourceful on machine design, improvement and maintenance.

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Mining engineering degree from technical school in high standing required; high scholastic record; some years experience in underground mechanized bituminous coal operations; desirable if experienced in modern mining methods, standard cost measurement and underground material handling.

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In sending personnel record, include complete description of education, experience, age, marital status, religion, compensation and recent photograph.

All information will be held in confidence. Send replies to:

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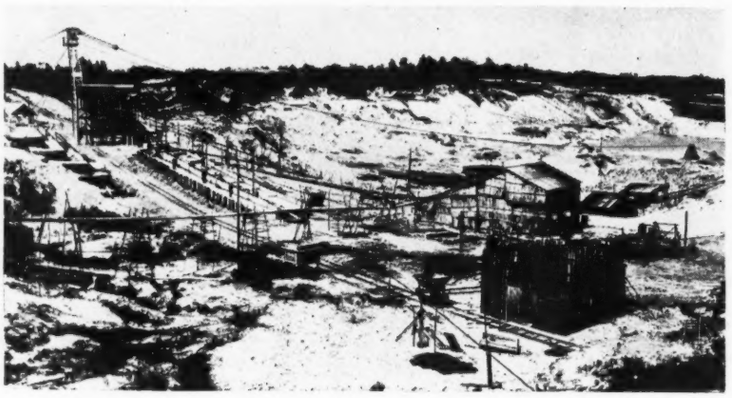


On Banka Island, in the Netherland East Indies, tin output by the Banka Tin-winning Company is increasing. The white earthy material containing small particles of tin is excavated by means of Sauerman buckets and slack-line cableways and tin is recovered in the long, wide sluice boxes seen at the foot of the large bin

▶AUSTRALIA

addition to oxidized ore from the Paringa leases.

▶The new plant of North Kalgurli (1912), Ltd., situated on the Croesus leases and shortly to come into operation, is expected to be one of the most economical on the field.

▶Investigation of an extensive deposit of alunitic clay at Lake Campion indicates a tonnage of 15,000,000, which on concentration it is estimated would yield 9,000,000 tons of alunite. The Government is financing construction of a pilot plant at the University of Western Australia to investigate the possibilities of the deposit as a source of potash and alumina. For the latter purpose, supplies of good-grade bauxite are deficient.

Victoria

▶Further developments continue on the Deborah anticline, at Bendigo, the latest being the cutting of the east back of the "inner reef" at 587 ft. north of the shaft on the 555-ft. intermediate level. Where cut, the back is 8 in. wide and carries visible gold.

▶Cessation of operations at the mine of Talbot Alluvials Ltd., Caralulup, marks the practical end of the attempt to resuscitate the deep-lead gold mining industry in Victoria, which commenced about six years ago. This mining method, which yielded very large quantities of gold many years ago, demands a special skill from the labor employed, a quality which seems to have largely died out as a result of the long inactivity of the deep-lead fields.

▶Argus Hill Chewton Gold, N. L., Chewton, has had a recent good development in the north drive at the 260-ft. level, 115 ft. from the shaft, where a network of spurs, highly mineralized and with visible gold, has come into the face.

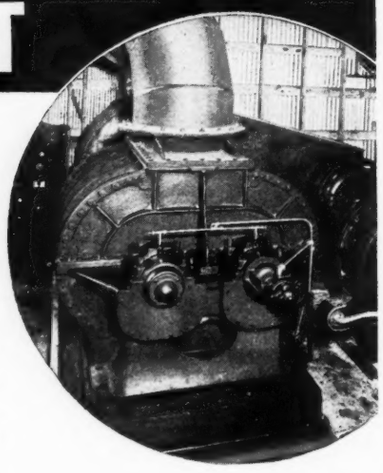
New South Wales

▶C. E. Blackett, general manager, reporting on the operations of New Occidental Gold Mines, N. L., Cobar, for the period Dec. 1, 1939, to May 19, 1940, states that at the New Occidental mine the main shaft has been sunk to 1,463 ft. below surface, and sinking is still in progress. Erection of the additional cyanide plant to treat the old Occidental company's residues and later New Cobar tailings has been delayed by non-delivery of plant items.

▶The old Dundurrabin copper mine, near Tyringham, 70 miles from Armidale, may be reopened. The property is under option to a Brisbane company.

(Continued on page 93)

LOW COST air



Roots-Connersville Rotary Positive Blowers ask no time out and require a minimum of maintenance, even on the toughest job. For flotation, smelting, converting, tunnel ventilation, acid plants, and all air and gas handling from 8 oz. to 15 lbs., low power consumption helps keep down the cost of your production. To boil it all down to one simple statement—"R-C" Blowers provide dependable, low cost air. Ask for further data.

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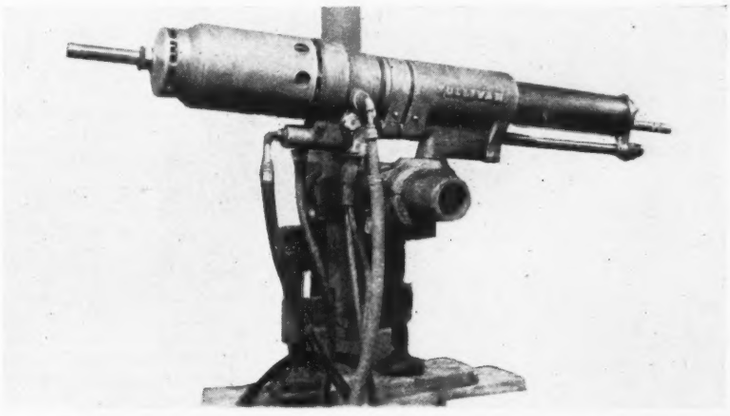
EQUIPMENT NEWS

Mining Industry Notes Many Advances in Equipment at Machinery Exposition

High-speed electric-driven rock drills for blasting purposes using diamond impregnated bits, and other electrical and mechanical devices for mine and mill use, offer efficiency to the mine operator

SOME 63 manufacturers of mining machinery exhibited their equipment at the exposition held in conjunction with the Seventh Annual Metal Mining Convention, American Mining Congress, at the Broadmoor Hotel, Colorado Springs, Colo., Sept. 16–19. Exceeding in size and quality all preceding equipment displays, the exposition, as on previous occasions, offered mine operators and engineers the opportunity to study new developments and talk over problems relating to mining and milling operations with manufacturers' representatives. The booths were of attractive design, and contained in many exhibits equipment in actual operation, including scale models. In addition to several new developments there were shown improved standard equipment and operating refinements that make for higher efficiency and lower costs. The exposition attracted a record attendance at all times.



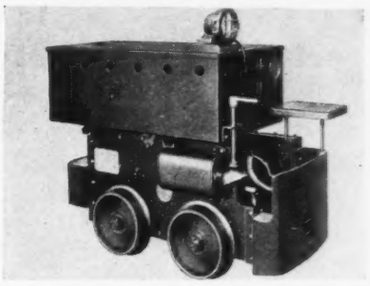
High speed electric driven rock drill of Sullivan Machinery Company

Among the developments that aroused the interest of the visitors was the new electric high-speed core drill using Koebelite bits demonstrated by the Sullivan Machinery Company, of Michigan City, Ind. The new unit consists of a drill head powered by a special G. E. motor using 440-volt current and operating at 1,800 to 3,600 r.p.m., and automatic and hand-feed mechanisms. Automatic feed is effected through a hydraulic cylinder, and the manually operated feedscrew is used solely for transporting the bit to the rock face and for spudding the hole. Dow metal, stainless steel, and heat-treated aluminum are used in its construction, and as a consequence the weight of the drill compares favorably to that of a large pneumatic drifter. Maximum drilling depth exceeds 175 ft.

Westinghouse Electric & Manufacturing Company displayed a 500-kw. Ignitron rectifier unit designed for use at one of the Southwestern copper mines. Development of the Ignitron principle has given to industry a power conversion unit for mining and many other applications—that is, wherever low-voltage direct current is required. Because of high efficiency at all loads, ability to carry high overloads suddenly imposed, and reliability in automatic, unattended operation, new low operating costs are being attained. A typical Ignitron installation consists of an oil circuit breaker connected between the high-voltage line and the rectifier power transformer; a transformer to convert high-voltage, three-phase power to low voltage; a rectifier consisting of six or more Ignitrons, with vacuum pumping and control devices; a direct-current circuit breaker connected between the rectifier and the direct-current bus; auxiliary devices (relays, meters, etc.) for the protection and control of the station; and a cooling system.

The outstanding feature of the Morse Bros. Machinery Company's new rake classifier is the patented rake movement. Known as the "Trueline" rake movement, the mechanism is of relatively simple design with a minimum number of moving parts; hence lower maintenance costs and uninterrupted performance. Additional advantages claimed by the manufacturer are increased metallurgical efficiency, smoother operations, and minimum headroom requirements. The new silent "Vari-Stroke" ore feeder is designed for feeding dry or wet crushed ore in uniform and predetermined quantities from ore bins to grinding units.

The General Electric Company demonstrated the 1½-ton storage-battery trammer placed recently on the market. The new unit is of compact construction—that is, dimensions are within the limits of standard cages—and interchangeable battery boxes provide for extra service capacity. With the front and rear bumpers removed, the trammer measures only 47x33 in. Outside wheels are easily demountable and adjustable between 18- and 24-in. gage. The battery is 36-A6, 22-MVM15 or equivalent, drawbar pull, 400 lb., and speed at D.B.P., 3 m.p.h.



New G.E. 1½ ton mine locomotive

The Dorrco V-type diaphragm pump shown at the exposition (scale model) is designed for handling sludges, pulps, or slimes, and incorporated in its design are features such as adjustment of the stroke during operation, ability to operate against small pressure heads, and low headroom requirements. The twin pumping chambers are of mechanite construction, each provided with individual suction and discharge valves of the ball type and constructed of lead-impregnated rubber, seating upon removable hard rubber rings, rubber diaphragms, and plunger rods. Power is furnished by a standard electric motor, and V-belts transmit it to the helical gear and pinion speed reduction mechanism. On the 4-in. duplex unit a 1½-hp. motor is required. Necessary headroom is 3 ft. 6 in., compared with 6 ft. 5 in. in the old design.

Ingersoll-Rand's new Jackleg

3 BIG GRAVEL PROBLEMS solved with help of PAN-AMERICAN JIGS

• Most Pan-American Jig installations come from our *solving an operating problem* for the operator. For example:

1 *10 million tons* of sand and gravel for Shasta Dam, California, will be processed for placer gold recovery, using Pan-American Jigs in accordance with our flowsheet recommendations.

2 *Sapphires* are being recovered as a by-product of gold-dredging by Perry Schroeder Mining Co., at Hauser Lake, Montana, using Pan-American Jigs as recommended by us.

3 *First in Alaska:* New dredge of Fairbanks Exploration Dept. of U. S. Smelting, Refining & Mining Co., operating on Cripple Creek, Alaska, is equipped with Pan-American Jigs. The gold recovery installation, first of its kind in Alaska, was designed in close cooperation with our engineers.

• We may be able to recommend a Pan-American Jig installation which will effect savings or help solve a problem in your operations too. Why not write us?

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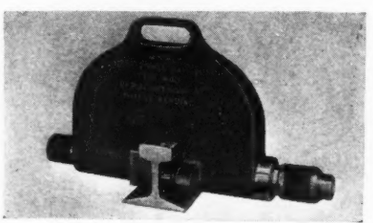
P A C E

Of interest to mining men was the Jackleg setup displayed by Ingersoll-Rand Company. Weighing only 35 lb., use of the device is said to have resulted in increase of footage drilled up to 50 per cent. The new unit contains few wearing parts, and hence upkeep is low, and a quick-locking bayonet connection makes it easy to remove the drill from the Jackleg whenever down holes or toe holes are to be drilled. A universal joint at the top of the Jackleg permits sufficient hand rotation of the jackhammer to free stuck steels. By setting the point of the Jackleg close to the face, thus giving a reverse feeding effect, a badly stuck steel can frequently be released without difficulty.

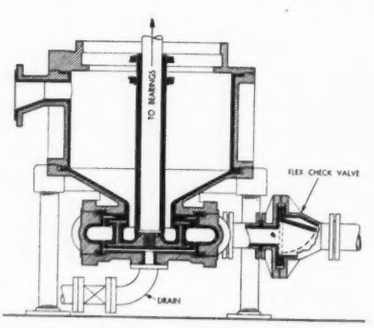
The new back-type, one-hour breathing apparatus developed by Mine Safety Appliances Company, Pittsburgh, Pa., contains similar features and employs the same principles of operation as the front-type unit. Working parts are protected by a sturdy cover made of aluminum, and total weight is 24 lb. The company's new "Velocity-Power" rail punch is a self-contained, portable tool



M.S.A. Velocity power punch

that utilizes the energy created by the discharge of a blank cartridge to punch holes through the web portion of mine rails. It measures $9\frac{1}{2}$x$16\frac{1}{2}$x$4\frac{1}{2}$ in. (Model R-40), and is capable of punching holes up to $\frac{3}{4}$ in. in rails varying in weight from 15 to 40 lb. Punches and dies are replaceable, and total weight of the device is 42 lb. Designed for making repairs on all types of mining machine cables quickly and effectively, the new "Velocity-Power" cable splicer may prove a valuable addition to the electrical maintenance department at mines, mills, and smelters. The Model T-1 unit may be used for splicing single conductor, duplex, or concentric cables ranging from 2/0 to No. 6, inclusive. Complete weight is 6 lb., and over-all sizes are about $8\frac{1}{2}$x$2\frac{5}{8}$ x$1\frac{1}{2}$ in.

Besides the new packless pump (described in *E.&M.J.*, August, 1940, issue, p. 121), Allen-Sherman-Hoff Company, of Philadelphia, Pa., displayed the new A-S-H Flex-Check valve. It is designed



Packless pump and flex check valve

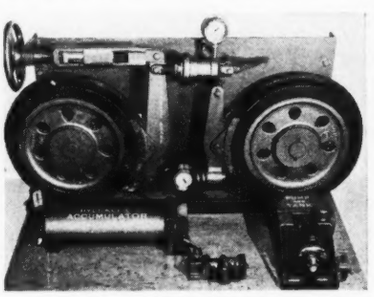
to cause a minimum of friction loss when open and its "self-hinging" construction holds "bottle tight" against back pressure. The valve, made in various sizes, is composed of only five parts, three of which are made of Maximix rubber or Neoprene. These can be quickly replaced in the field when necessary.

The "Mine-Vent" automatic coupler developed recently by the American Brattice Cloth Company, Warsaw, Ind., is said to offer the following advantages: Purchase of tubing in economical long lengths, cutting of tubing underground, utilization of all small lengths,

"Mine-Vent" automatic coupler

quick repairs, and rapid installation of new tubing. The coupler consists of two rings of oil-tempered spring steel wire, and a steel clamp made from 22-gage newly developed "Zinc Grip" steel (rust proof). It may be used with either single- or double-seam tubing.

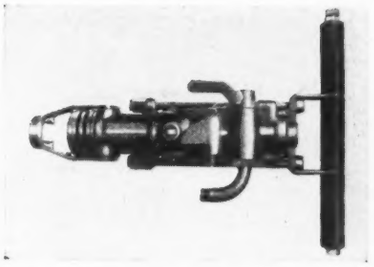
The Jeffrey Manufacturing Company, Columbus, Ohio, demonstrated the new hydraulic braking system for mine locomotives. The complete unit consists of a tank, motor and pump, accumulator, control valve, and brake cylinders, and



New hydraulic brake system by Jeffrey

can be easily and quickly installed on mine locomotives. It is said to give quicker and more effective braking action than hand brakes, and requires a relatively small amount of space. All units of the mechanism are joined with hose and tubing, thus permitting complete flexibility of installation. The brake system also utilizes the same levers and shoes as the screw brake, which is retained for secondary use.

Other developments that drew the interest of the visitors included the Goodman shaking conveyor equipped with a Type G universal drive used underground at several Southwestern copper mines, the new rubber mounted drive mechanism on the W. S. Tyler Company's Ty-Rock full-floating screens, the new DuPont bench-type cap crimper,

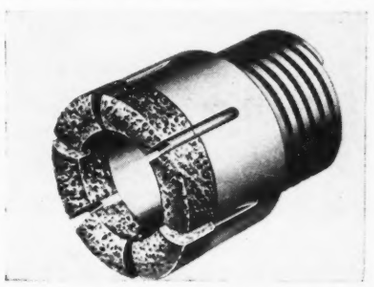


Gardner-Denver's new S-33 sinker

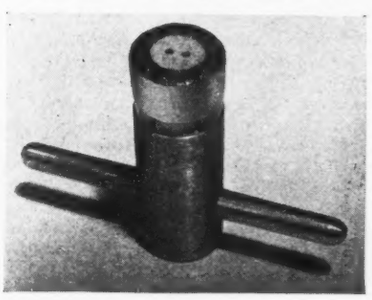
the new line of pipe fittings in conducting fluids and gases in pipe systems displayed by Victaulic Company of America, the single-bearing, rolling self-aligning trunnion roller for mills and rotary kilns by SKF Industries, Inc.; electrical insulation material by the Owens-Corning Fiberglass Corporation; the new McCool Pulverizer by Mine & Smelter Supply Company; the new S-33 lightsinker and other drills by Gardner-Denver Company; a new line of drifters and stopers by The Cleveland Rock Drill Company; the new electric assay furnace of the Denver Fire Clay Company; the new Amodyne blasting powder by Atlas Powder Company; and many pieces of improved equipment.

Advance in Diamond Drill Core Bits

HIGHER DRILLING SPEEDS and the ability to recondition a diamond bit quickly without hand or cast setting are features of a new technique involving the use of diamond-impregnated core-drill bits, known as "Sinta Set," announced by the Carboloy Company, Inc., Detroit, a subsidiary of the General Electric Company. Following three years of experimental work in core drilling in iron, copper, gold, and lead mines, the company based its bit design on results of continuous field experiments supplemented by extensive laboratory research, with different types and sizes of bits.

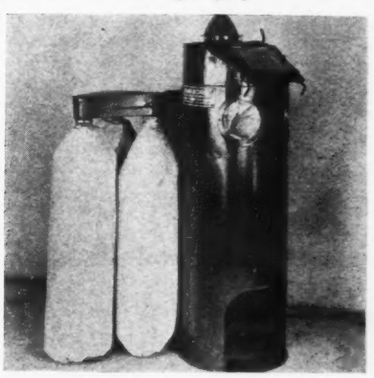


Bort diamonds are impregnated into a carbide matrix with equal distribution



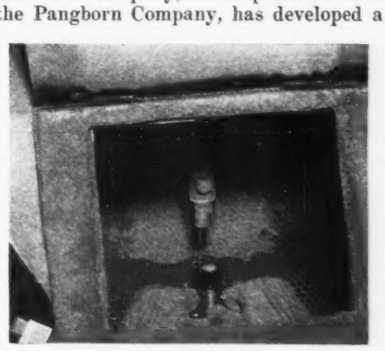
Preparations for sharpening involve placing friction tape on outside diameter, plugging hole with rubber cork, and screwing onto a holder

A cemented carbide matrix into which has been impregnated industrial virgin bort diamonds forms the crown of the bit. The diamonds are small and are greater in number than in the conventional core bits and distributed throughout the matrix. Study of diamond distribution is said to have been worked out in such a manner that distribution compensates for the difference in cutting speed between the outside and inside of the core bit, assuring equal wear over the crown and consequent increased life between reconditionings. Two methods used to accomplish this are, first, control of the diamond distribution in the matrix itself, and, second, the use of tapered segment inserts or tapered waterways. The bits are produced by molding and sintering the matrix material in which the diamonds have been previously distributed. The ability to use molds for this purpose is said to insure absolute maintenance of close tolerances on the finished bits, thereby eliminating reaming holes, as one bit will follow any other down the hole. The matrix is said to be so hard that in drilling highly abrasive materials wear is just sufficient to maintain proper cutting clearance for the diamonds. In less abrasive materials, occasional sand blasting provides the necessary reduction of matrix material to maintain cutting clearances. Thus, wear of diamonds themselves is said to virtually control wear of the bit as a whole.



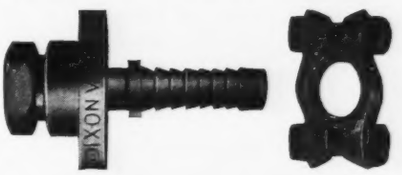
Sharpening equipment consists of a portable sand-blast unit, with motor and dust-collecting sacks

Sand blasting is used to sharpen the bit. The company, in cooperation with the Pangborn Company, has developed a



Bit screwed on holder is securely held under the sand blast, requiring from two to five minutes for resharpening

Their TIGHT GRIP Keeps Pressure UP... Service Costs DOWN!



"DIXON"

WASHER TYPE

AIR HAMMER COUPLINGS

These dependable couplings fit and grip the hose ends *so tightly* that leaks and pressure losses are eliminated, and the drill, hammer or spade allowed to operate at maximum efficiency and, consequently, minimum cost. Strong, durable, easy to install . . . the most inexpensive QUALITY couplings you can buy for air tool service. Cadmium plated—rustproof.

Compact Type, Style WLD-7, ½" and ¾"
Heavy Type, Style WHD-9, ¾" and 1".

"GJ-DIXON"

GROUND JOINT

AIR HAMMER COUPLINGS

Same as above, except *washerless*. The ground joint union consists of a copper insert in spud fitting against accurately rounded head of the steel stem and forming a soft-to-hard metal seal that remains leak-proof, regardless of wear. No washers to wear out or be mislaid. Cadmium plated—rustproof. Furnished with male or female spud.

Compact Type, Style XLD-41, ½" and ¾".
Heavy Type, Style XHD-52, ¾" and 1"

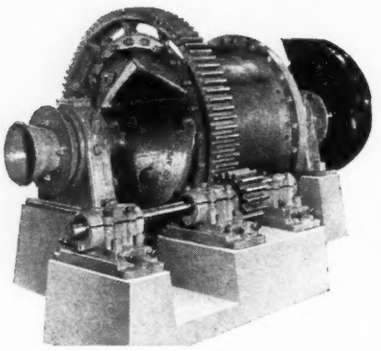
On your next order, be sure to specify "DIXON" or "GJ-DIXON" Air Hammer Couplings. Your Rubber Manufacturer or Jobber stocks them for immediate delivery.

DIXON
VALVE & COUPLING CO.

MAIN OFFICE AND FACTORY: PHILADELPHIA, PA.
Branches: Chicago—Birmingham—Los Angeles—Houston

"GRINDING EFFICIENCY EXCEPTIONALLY HIGH"

"Ruggedly Constructed"



are comments accompanying a recent repeat order for two Williamson Mills from a large mining company.

Williamson Mills are different—their effective grinding cascade efficiently produced by a scientifically designed drum, assures lower cost operation—the advantages year in and year out of less power, ball and liner consumption per ton of ore ground.

"It's the shape of the drum that does it"

Write us about your grinding problem—we can help you.

WILLIAMSON COMPANY

582 Market St. San Francisco, Calif.

portable sand blast machine, which can be operated near the drilling station, underground or on the surface. The sharpening unit is composed of a blast-cabinet dust exhauster, motor, and dust collector bags. When sharpening a bit, the inside diameter is fitted with a rubber plug, and friction tape is applied to the outside diameter, and the bit screwed into a holder and placed beneath the sand-blast nozzle. Reconditioning is said to require only five minutes. Carboloy officials estimate that bit inventory is reduced by 60 per cent for the average drilling job, by this method.

Sale of these bits will be handled directly to the user, by the Carboloy Company, and also through certain manufacturers of mine drilling machinery. In this connection, development is being carried on at present by machinery manufacturers in the direction of lighter-weight higher speed equipment for blast-hole drilling with "Sinta-Set" core bits, to take advantage of the higher drilling speeds possible with these new bits.

INDUSTRIAL NOTES

Ananconda Copper Mining Company and its subsidiary The American Brass Company announce the production of a two-reel 16-mm. silent film in natural color and black and white showing how copper ore is mined, smelted and refined; the alloying of copper to make brass; and the fabrication of copper and copper alloys. This motion picture is available without charge from the following sources: Y. M. C. A. Motion Picture Bureau, New York and Chicago; Anaconda Copper Mining Company, 25 Broadway, New York City, and The American Brass Company, Waterbury, Conn.

For a SAFE, PROFITABLE INVESTMENT, choose-

SuperDuty DIAGONAL-DECK CONCENTRATING TABLES

The SuperDuty Table presents an entirely new idea in concentrating tables. It does not "pass the buck."

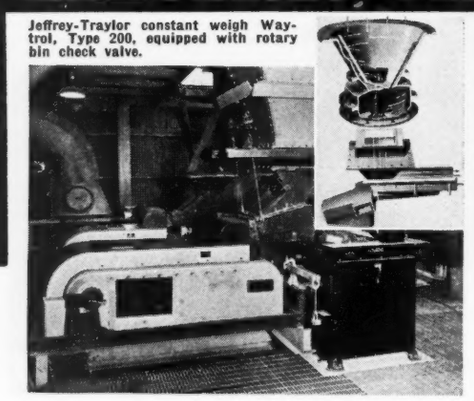
The SuperDuty Table is a complete machine with adequate built in frame and support members—factory aligned and factory finished as the manufacturer's responsibility and contribution to 100% user satisfaction. It embraces more than just a head motion, deck and a few slide bearing units for which the customer provides adequate frame and support elements to complete the machine at his own expense and responsibility.

Write for details . . . No obligation

THE DEISTER CONCENTRATOR COMPANY

THE ORIGINAL DEISTER CO.
INCOPORATED 1906
905 GLASGOW AVE · F T. WAYNE, IND.

JEFFREY-TRAYLOR ELECTRIC VIBRATION



Jeffrey-Traylor constant weigh Waytrol, Type 200, equipped with rotary bin check valve.

...A PRINCIPLE THAT SPELLS *Lower Cost Material Handling!*

AS AN EXAMPLE... BETTER CRUSHING RESULTS FROM THIS ALL-ELECTRIC BIN-CHECKED WEIGH FEEDER.

● Uniform feed gives greater efficiency in the operation of reduction units . . . that's why Jeffrey-Traylor weigh feeders and rotary bin valves (patented) have steadily lowered costs in this phase of metal mine service. By high frequency electric vibration, a uniform head of material is always available . . . this, in turn, is controlled by the "electric brain" of the Waytrol thus assuring a constant, positive feed for ball mills, crushers, etc. This sound principle of electric vibration, plus electric control, is a feature of J-T screens, feeders and conveyors. Let us demonstrate the many benefits with a system that's entirely electrical. Write for Catalog No. 650—J.

JEFFREY-TRAYLOR DIVISION

The JEFFREY MANUFACTURING Company

974-99 NORTH FOURTH STREET . . . COLUMBUS, OHIO

Cleveland Rock Drill Company announces the appointment of Clarence L. Seaman as district manager of the company, with headquarters in Berkeley, Calif. The company also announces the opening of an office with service and supplies at Wallace, Idaho. Clarence F. Zeuch, mining engineer, is in charge. The New York City office of this company was recently moved to 30 Church St., with Samuel McCart district manager.

The Copper and Brass Mill Products Association and Copper & Brass Research Association have been merged under the name of Copper & Brass Research Association, the address remaining 420 Lexington Ave., New York.

The Portable Lamp & Equipment Company, 78 First Ave., Pittsburgh, Pa., announces the appointment of Carl J. Coggeshall as mine lamp engineer. Mr. Coggeshall was for several years connected with the electrical section of the United States Bureau of Mines. Another recent appointment is that of H. A. Hill as mechanical engineer for the company.

Oliver United Filters, Inc., announces that all sales and servicing of its metallurgical equipment—Oliver, American, and Dorrco continuous vacuum filters, auxiliaries, and replacement parts—is now being handled by E. Long, Ltd., Orilla, Ont., which company will continue to manufacture these filters. This

arrangement applied to the provinces of Ontario, Quebec, Manitoba and Saskatchewan.

Mechanical Supplies, Inc., announces the purchase of the business and stock of the Berry Engineering Company, Manila, Philippine Islands. Donald B. MacAfee, P. O. Box 1177, Manila, is president and general manager of the new corporation.

Controlling interest in Vulcan Iron Works, Wilkes-Barre, Pa., has passed to new owners, and E. P. Holder has been elected president. The company will continue production of its varied line of mining machinery, and will make available to the Government its excess manufacturing facilities for the production of certain types of equipment for national defense.

John A. Roebling's Sons Company has appointed William P. Laseter as export manager of its new export division located at 19 Rector St., New York, N. Y.

Chicago Pneumatic Tool Company announces the appointment of P. J. Christy as manager of its Philadelphia, Pa., office. He succeeds A. M. Brown, who has been transferred to Washington, D. C., as manager of the new branch recently opened there. The company also announces the appointment of C. A. Diehl as manager of the Houston, Tex., office.

Sorel Steel Foundries, Ltd., announces the appointment of J. D. Patterson as sales representative for the Quebec and Ontario mining districts, with headquarters at Kirkland Lake, Ont. Mr. Patterson until recently was connected with the Canadian Sullivan Machinery Company, Ltd., of Dundas, Ont. J. A. Critchley, of Sorel Steel Foundries, will continue to visit the mining districts.

R. E. Friend, president Nordberg Manufacturing Company, Milwaukee, announces that Clinton E. Stryker has been appointed vice-president and assistant to the president of the company.

BULLETINS

Electric Generator Units. Weber Engine Co., Kansas City, Mo. Bulletin 1 describes and illustrates the manufacturer's line of electric generator units for various industrial needs. Pp. 4.

Packings. Garlock Packing Co., Palmyra, N. Y. Form AD 131 describes and illustrates features of the company's new lattice-braid packing materials. Pp. 11.

Copper Products. Revere Copper & Brass, Inc., 230 Park Ave., New York, N. Y. Bulletin devoted to tables of weights and sheet copper, roll and strip brass, tubes and wire. Conversion tables and general engineering data are also included. Pp. 33.

Magnetic Separators. Magnetic Engineering & Mfg. Co., Clifton, N. Y. Catalog 340 describes and illustrates the manufacturer's magnetic drums and drum-type separators. Pp. 4.

Core Drill. E. J. Longyear Co., Minneapolis, Minn. Bulletin 58 describes and illustrates the company's master straight-line diamond core drill for deep drilling. Pp. 4.

Rock Drill Accessories. Ingersoll-Rand Co., Phillipsburg, N. J. Booklet 2410 describes and illustrates the company's line of rock-drill accessories. Pp. 12. **Motor-blower.** Form 2671 describes features of the company's three-stage Type G motor-blower. Pp. 7.

Motors. Allis-Chalmers Mfg. Co., Milwaukee, Wis. Bulletin B-6033 illustrates and describes the manufacturer's larger coupled and engine-type synchronous motor. Pp. 27. **Jaw Crushers.** Bulletin

ALWAYS DEPENDABLE ALL WAYS THE BEST

HENDY MINE CARS

EASY TO DUMP . . . EASY TO ROLL

Ask the man who operates them

HENDY FURNISHES COMPLETE MINE AND MILL EQUIPMENT

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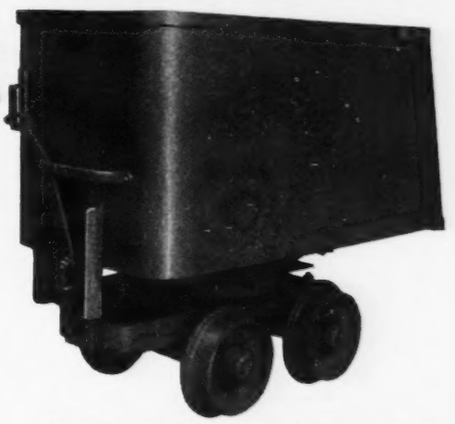


Made in the usual sizes with either Automatic or Lever Door Release—Side or End Dump.

JOSHUA HENDY IRON WORKS

Address: Sales Office 206 Sansome St., San Francisco, California

Cable "Hendy"

Sauerman LONG RANGE MACHINES

50,000-ton open storage at mill handled by 2 cu. yd. SAUERMAN Scraper.

10 to 1,000 tons per hour

Long reach, simplicity of installation, low cost operation and adaptability to unusual ground conditions are features of SAUERMAN Power Drag Scrapers and Cableway Excavators that recommend these machines for a variety of surface mining jobs and the handling of all kinds of bulk materials.

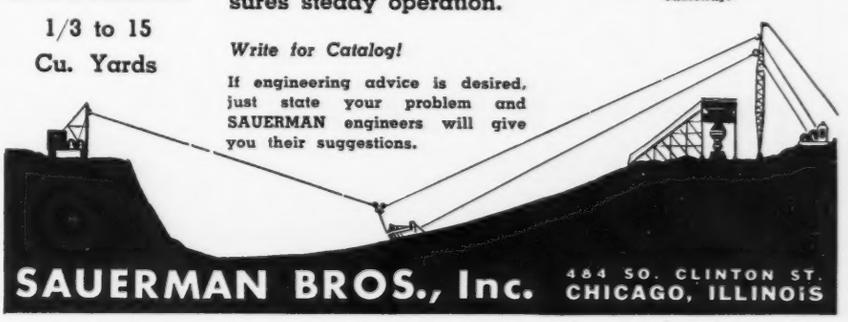
Huge culm pile is reclaimed to briquet plant by 3 cu. yd. SAUERMAN Cableway.

Because of their unique design these machines require a minimum of elaborate machinery, making it extremely practical to set them up at inaccessible places. With few moving parts to get out of kilter, a small replacement inventory insures steady operation.

BUCKETS 1/3 to 15 Cu. Yards

Write for Catalog!

If engineering advice is desired, just state your problem and SAUERMAN engineers will give you their suggestions.



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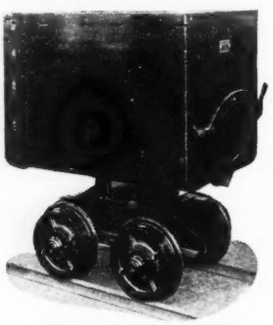
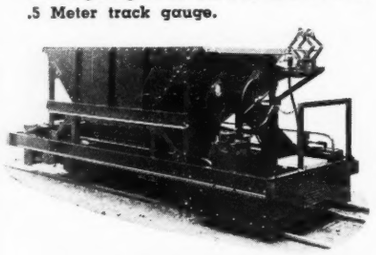
ATLAS
MINE AND SMELTER CARS

● Atlas specializes in the design of cars and accessories for economical handling everywhere. Two such cars are shown here — the various types and sizes . . . both in standard and special designs . . . available to suit the particular conditions for which they are required. Trolley or storage battery power can be supplied. Dump buckets of various descriptions are made in dimensions and capacities to suit your specifications.



ROTARY DUMP CAR

One of a lot of 60 Rotary Dump Mine cars. This car is arranged to dump all around, i. e. on either side or either end. The capacity is 16 Cu. Ft., and it is for .5 Meter track gauge.



CENTER BOTTOM DUMP CAR

6-Ton Capacity Bottom Dump Electric Car. Car has double undercut discharge gates to dump the load cleanly between the tracks. The drive is by means of a 7½ H. P. slip-ring motor connected by means of a flexible coupling to Atlas Double Reduction Totally-Enclosed Spur Gear Drive Speed Reducer of the Transfer Car type.

This car is also equipped with a thrustor-operated electric brake, which is arranged to apply in an emergency only, in the event that the power fails or that the car runs beyond the limits of its regular travel, in which case the trolley circuits are automatically opened.

● *Write us for detailed information on our complete lines—we will gladly make recommendations.*

The Atlas Car & Mfg. Company
1100-1150 Ivanhoe Road, Cleveland, Ohio

B-6034 covers the four general types of crushers, the fine reduction, Dodge, Blake, and Superior, illustrating and describing each. Pp. 27. **Screens.** Bulletin 6088 describes and illustrates operating features of the company's new Sta-Kleen Screen. Pp. 7. **Motors.** Bulletin B-6002 describes large direct-current motors and control for heavy-duty drives. Pp. 40.

Portable Electric Saws. Black & Decker Mfg. Co., Towson, Maryland. Serving as a handbook, and explaining factors in portable saw design, the book is well illustrated with applications of portable electric saws for various industries. Pp. 24.

Mineral Jigs. Denver Equipment Co., Denver, Colo. Bulletin J2-B describes and illustrates features and applications of the company's jig in the metallic and nonmetallic mining fields. Pp. 15. Filters. Bulletin F8-B describes and illustrates the Denver rotary and vacuum filters. Pp. 7.

All Service Gas Mask. Mine Safety Appliances Co., Braddock, Thomas & Meade Sts., Pittsburgh, Pa. Bulletin EA-4 describes and illustrates features of the company's new all-vision facepiece gas mask. Pp. 2. **Carbon Monoxide Indicator.** Bulletin DS-2 describes and illustrates features of the company's hand-operated carbon monoxide indicator. Pp. 1. **Eye Protector.** Bulletin CE-8 describes features of the company's many types of protective lenses, for goggles, spectacles, welding helmets, and shields. Pp. 8. **Adjustable Goggles.** Bulletin CE-7 describes and illustrates a type of goggles called the Speed frame mounted in a headframe, so designed that a simple nod of the head, positions the goggles in front of the eyes, or a nod will throw them up and out of the way. P. 1. **Trolley Guard Hanger.** Bulletin BH-5 describes the M.S.A. trolley guard hanger. P. 1.

Microprojector. Bulletin CT-4 describes and illustrates the company's instrument that projects an image of a microscope's field upon a ruled vertical, translucent screen providing a magnification of 1,000 diameters for counting and 10,000 diameters for particle size determination. P. 1. **One-Hour Oxygen Breathing Apparatus.** Bulletin BM-2 describes and illustrates the company's back type model oxygen breathing apparatus supplying protection for one hour. Pp. 4.

Quenching and Tempering. Standard Oil Co. of Indiana. Chicago, Ill. Q-129 is called an engineering bulletin on the heat-treating of steel, annealing, hardening and tempering and the difference explained between quenching and tempering oils. Pp. 22. **Rust Prevention.** RP-30 explains the methods of applying petroleum rust preventions and their numerous uses. Pp. 21.

Valves. Reading-Pratt & Cady Division, American Chain & Cable Co., Reading, Pa. Booklet DH-1186 contains dimensions and application recommendations for bronze, carbon steel, and stainless steel bar stock valves. Pp. 15.

Crusher. Straub Mfg. Co., 504 Chestnut St., Oakland, Calif. Bulletin No. 39 describes and illustrates the company's new Kue-Ken crusher, including field facts and figures. Pp. 4.

Mechanical Rubber Goods. B. F. Goodrich Co., Akron, Ohio. Catalog is devoted to rubber transmission belting, conveyor belts, hose fittings, engineering data, and a guide to selection of products for various industrial uses. Pp. 22.

Brazing Alloys. Handy & Harman, 82 Fulton Street, New York, N. Y. Folder describes the manufacturer's Sil-Fos and Easy-Flo brazing alloys. Pp. 4.

Transformers. Allis-Chalmers Mfg. Co., Milwaukee, Wis. Bulletin B-6096 describes and illustrates the company's latest distribution transformers.

Valves and Couplings. Knox Mfg. Co., 817 Cherry St., Philadelphia, Pa. Catalog 14 describes and illustrates the manufacturer's complete line of valves couplings, nipples, clamps, and menders for rock-drill air lines and water lines. Pp. 40.

Sand Pumps. Allen-Sherman-Hoff Co., Lewis Tower, Philadelphia, Pa. Catalog 140 describes and illustrates features of the company's line of Hydro-seal pumps for pumping sand, slime, sludge and slurry. Engineering data on specific gravity of solutions, and friction of water in pipe, together with performance tables are included. Pp. 31. **Packless Pump.** Bulletin 1239 describes features of the manufacturer's new packless pumps with automatic suction control. Pp. 4.

Industrial Lubrication. Sun Oil Co., 1608 Walnut St., Philadelphia, Pa. General descriptive catalog, highly illustrated, of the company's lubricating products used in the mining and other industries. Pp. 34.

THE ROSS FEEDER
Completely Controls

the flow of any size material from Storage Bins, Hoppers or Open-Dump Chutes to Crushers, Conveyors, Screens, etc.

High in efficiency. Low in maintenance and power consumption.

Furnished in sizes to suit your operation. Scalping unit to fit your chute if desired. Send full particulars for recommendation.

ROSS SCREEN & FEEDER CO.

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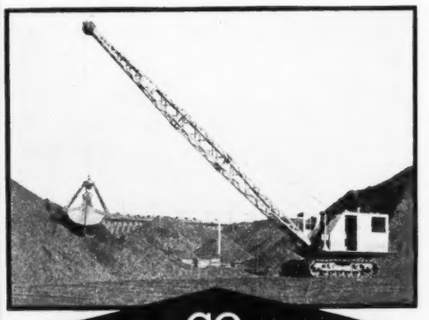


GO WHERE THE WORK IS

Bucyrus-Erie clamshells are not tied down to tracks but can go anywhere in your yard. They can unload material from boats and stock-pile it, load from stock-piles to hoppers or direct to cars and trucks. They're ready, at a moment's notice, to go where you need them. And they have the speed and control to work fast when they get there. Ask us to show you how one of these modern machines can save you money.

BUCYRUS-ERIE CO.
SOUTH MILWAUKEE, WIS., U. S. A.

Diesel-Electric Locomotives. General Electric Co., Schenectady, N. Y. Bulletin GED-803 describes and illustrates the manufacturer's line of diesel electric locomotives for serving various industries. Pp. 19. **Flamenol.** GEA-2733 D describes features and applications of the company's synthetic compound used for insulating wires and cables. Pp. 4.

Air Circuit Breaker. Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa. Booklet 2243 describes and illustrates in color the company's line of air and compressed air circuit breakers. Pp. 16. **Mill Motors.** Descriptive data 4074 describes the manufacturer's Type MC heavy-duty d. c. mill motors for mine hoists, conveyors, and other heavy-duty uses. Pp. 8.

Hoisting Equipment. Yale & Towne Mfg. Co., Philadelphia, Pa. Catalog PD-25 compares the three types of chain hoists and describes and illustrates various types of chain hoisting equipment. Pp. 44. **Air Cooled Electric Hoist.** Catalog W-39 describes and illustrates features of the manufacturer's electric hoists from ¼- to 6-ton capacity. Pp. 41. **Electric and Hand Lift Trucks.** Catalog P-442 describes and illustrates the company's line of trucks for many industrial uses. Pp. 60.

Hydraulic Jacks. Blackhawk Mfg. Co., Milwaukee, Wis. Catalog 40 H describes and illustrates the manufacturer's line of hydraulic hand jacks, wheeler floor jacks, and hand-operated and motor-driven hydraulic tools for various industrial uses. Pp. 20.

Mechanical Rubber Goods. United States Rubber Export Co. Ltd., Rockefeller Center, New York, N. Y. Folder describes and illustrates the company's belts, hose and packing, for industrial and general use. Pp. 6.

▶AUSTRALIA

Queensland

▶Mount Morgan, Ltd., shut down its smelter on July 7 for the purpose of carrying out extensions designed to increase the monthly output of copper from 400 to 500 tons. The extension will assist in overcoming the present shortage of copper in Australia. Operations started early in September.

▶Golden Plateau, N. L., Cracow, has run into 5-dwt. ore on the No. 4 level of its mine, the occurrence being somewhat unexpected, as exploration in this section some years ago did not give much result.

Fiji

▶A new main shaft is to be sunk at the Emperor mine, Tavua, Fiji, initially to 650 ft. with an extension later to 1,000 ft. This shaft is to be equipped to handle underground working on the scale which will be necessary when opencut operations are ended. Additional grinding equipment has been ordered for the mill, to enable throughput to be maintained with the harder ores now being treated.

▶At the Loloma mine, the main south drive on No. 2 level has been in values up to 1,603 ft. south of the shaft, where the shear split. One branch, carrying 8-dwt. values over 16 in., is now being followed. Drives on Nos. 3 and 4 levels have encountered the low-value zones met on No. 2, but already on No. 3 better values are met. At No. 5 level, a total of 89 ft. of driving has been done. Values have averaged 5.6 dwt. only, but the lode shear is very strong. It is planned to increase mill capacity, at present about 650 tons weekly, and it is probable that a flotation unit will be erected to deal with the lower-grade ores.

PLUS *Values*

IN PULVERIZERS... for "KEY MEN of MINING"

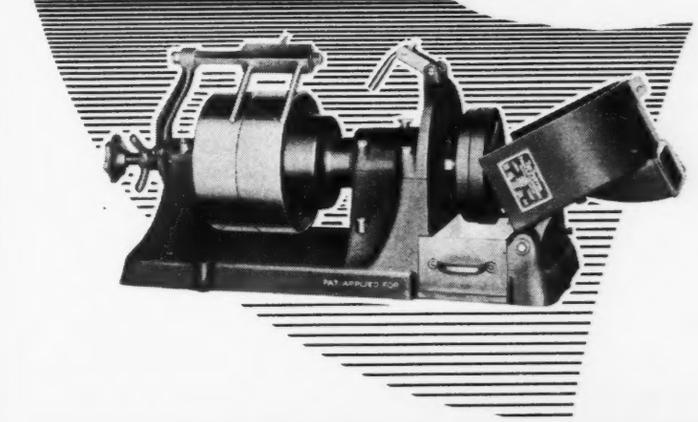
Daily, month after month, the Assayer's determinations "hit it on the nose." THEY HAVE TO! They are the basis of settlement for the mine's whole production. They govern development work. They control milling procedure. Yes, the Assayer is a KEY MAN OF MINING.

DFC PULVERIZERS

Equip your Assay Office with DFC Pulverizers—for they too "hit it on the nose" for efficiency, accuracy, speed, and long, trouble-free life.

Only the DFC Pulverizer offers you the marked advantages of "Direct Gyro-Shaft Drive" and 7 other PLUS VALUES of importance.

Bulletin 202 is packed with information; ask for your copy today.



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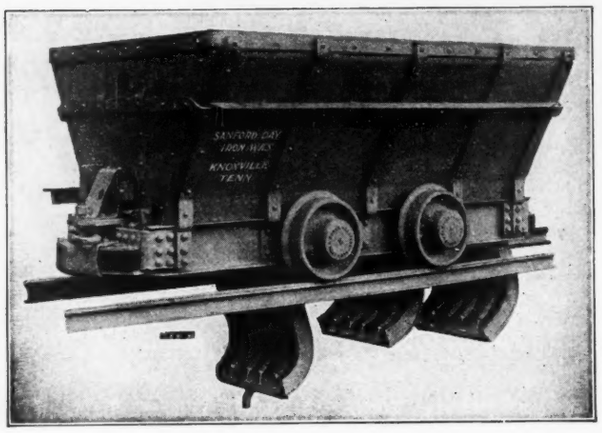
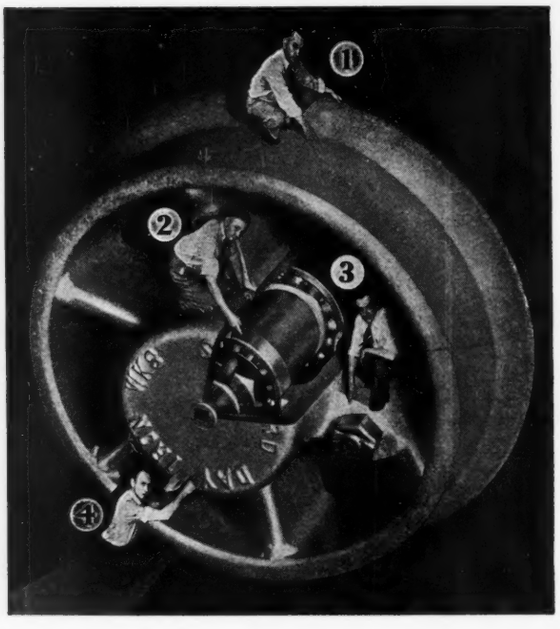
You CAN'T BEAT this combination!



FOR FAST, LOW COST PERFORMANCE

S-D "Automatic" Bottom Discharge Ore Cars . . . S-D "Floater" Ball Bearing Wheels . . . the perfect combination for a long life of low cost performance. S-D "Automatics" abolish dumping labor, cut power cost, and speed up production by continuous operation. 20 cars per minute may be discharged and closed by their simple forward movement across the storage bin. The S-D "Floater" Wheel is the result of 35 years of scientific wheel development. Customers specify it on ninety per cent of the cars we build. Put this money saving combination to work . . . lower power bills . . . step up production . . . with "Automatics." Drop us a line now . . . ask us where these big savings come from.



1—Deep chilled treads . . . true shape . . . with Sanford-Day's Patented annealing process. 2—The S-D "Floater" Bearing . . . permits automatic adjustment of bearings . . . no chance of pinching. 3—Demountable, like automobile wheels. By removing lock nuts, wheel may be slipped off axle, while bearings remain in place in perfect adjustment. 4—Solid closed hub . . . no loose caps . . . no projecting axles . . . no grease leakage.

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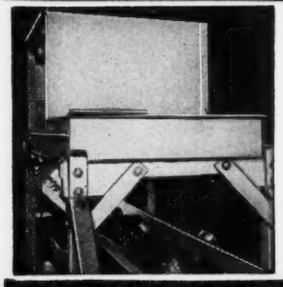

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